Dr. P. E. MOHAN.

REPAIR AND PRESERVATION OF RECORDS

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NATIONAL ARCHIVES OF INDIA

REPAIR AND PRESERVATION OF RECORDS

(Revised edition)

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PREFACE

The earlier two editions of this brochure, published in September 1959 and November 1966 respectively, were well received by archivists, librarians and custodians of manuscript repositories. There has been a constant demand for it, and it is growing with the establishment of more libraries and archival institutions. This little pamphlet, designed specially for lay men, appears to enjoy a special popularity even after two decades. It is now getting out of stock, and so a third edition, thoroughly revised and substantially enlarged, is being brought out.

The new chapters, 'Essentials of a Record Room' and 'Care of water and Fire Damaged Records' have been added, as well as two new appendices, 'Carboxy Methyl Cellulose Adhesive for Repair of Documents with Tissue Paper & Chiffon' and 'List of firms dealing in repair, preservative materials and other allied equipments'. The Bibliography has also been up-dated.

I hope this brochure will continue to provide practical guidance to those whose concern is to preserve records and other allied materials for posterity.

I am grateful to my colleagues Shri R. C. Gupta and Shri Ranbir Kishore, who had prepared the text of the earlier editions, and who have now worked to make it more comprehensive and up-to-date.

NEW DELHI
August 1978.

S. N. PRASAD
Director of Archives.

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I. PRESERVATION OF RECORDS

Deterioration of paper which has been used for writing and printing purposes during the past few centuries is quite common. In certain cases it has been observed that paper in recorded files and books which have not even been much used has yellowed and become brittle. These changes depend on the chemical composition of paper and ink, and are influenced to a large extent by the storage conditions. Preservation of records, therefore, not only requires maintenance of ideal storage conditions, but also judicious selection of paper and ink for writing.

Selection of record materials, paper and ink

The grades of pulp used in the manufacture of paper, the extent of bleaching, the quality and amount of sizing and loading materials used and the total acidity in paper determine its value for permanent preservation. Specifications of paper expected to last permanently have been laid down in many countries like U.S.A., U.K. etc. The Indian Standards Institution has also finalised IS: 1774-1961 Specification for Paper for Permanent Records. Excessive acidity in ink is a factor in degrading even good quality paper. Specifications for writing inks for permanent records have therefore been laid down by the Indian Standards Institution IS: 221-1962 (Revised). These specifications will help the various agencies interested in the preservation of their records in selecting the proper grades of materials.

Influence of climatic conditions, temperature and humidity

Paper and other record components, *e.g.*, leather, sewing thread, board, paste, glue etc., used in binding, are affected by high temperature, too high or too low humidity, dust and acidic gases in the atmosphere, and sunlight. Paper kept in a hot and dry climate becomes brittle; leather and board get desiccated under similar conditions. In the presence of excessive humidity paper often tends to crumple and become soggy. Extreme

variations in temperature such as 10°C(50°F) in winter and 45°C (113°F) in summer, experienced in many places in India, also affect the flexibility of these materials.

Temperature and relative humidity of the atmosphere above 32°C (90°F) and 70% respectively result in the growth and propagation of pests like book-worms, silver-fish, cockroaches and termites etc., as well as a variety of fungus commonly known as mildew.

Atmospheric pollution: acidic gases and dust

The presence of acidic gases in the atmosphere, especially sulphur dioxide and sulphurated hydrogen in the polluted air in industrial towns, has a deleterious influence on paper. It has been observed that the paper of records and books deteriorates more rapidly in a city than in its suburbs. Dust particles present on a paper, leather, board etc. act as nuclei for the condensation of acidic gases and propagation of mildew spores. These particles get embedded in paper, leather, etc., and subsequent flexing of these materials produces an abrasive effect on their surfaces and damages the fibres. Their presence on these organic materials creates unhygienic conditions and favours the growth of mildew.

Direct sunlight

Direct sunlight is regarded as an enemy of records. The phenomenon of discolouration and eventual deterioration of newsprint or other similar paper made of mechanical wood pulp when exposed to direct sunlight for prolonged hours, is very common. Besides, gradual fading of dyestuffs in writing ink is also accelerated by exposure to sunlight.

Storage conditions: regulation of temperature and relative humidity by airconditioning

It has been observed that maintenance of controlled temperature and humidity of the air in the storage area is of considerable value in preserving records. Temperature and relative humidity most suitable for the proper preservation of paper and

other record materials range between 22°-25°C (72°-78°F) and 45-55% respectively. Regulation of temperature and relative humidity in the above range is only possible with the help of an elaborate airconditioning plant. In the airconditioning system it is also possible to treat the air with alkaline water having a pH of 8.6 or above, so that acidic gases in the atmosphere may be neutralized. Heavy dust particles are also eliminated in the air-wash system.

Dehumidification by dehydrating chemicals

Airconditioning involves high initial cost of installation and may not be within the means of comparatively smaller record offices and libraries in India. In the absence of airconditioning the only method of minimizing the deleterious influence of excessively high humidity is the use of dehydrating agents. Anhydrous calcium chloride and silica gel are quite satisfactory as dehydrating chemicals for use in record offices. Although initial expenditure in silica gel dehumidification may be more than calcium chloride, yet it is economical in the long run as silica get can be reactivated for re-use after heating the saturated chemical in open pans. The quantity of silica gel to be used for a specific room capacity will depend on room temperature, rate of air circulation and moisture content of the outside atmosphere. However, approximately 2-3 kg. of silica gel may be sufficient for a room of 20-25 cu. metre capacity. The requisite quantities of silica gel may be spread in dishes and kept in different places in the room. Use of silica gel in wire net pockets fixed on wooden frames and kept on shelves may give better results. After use for 3-4 hours the silica gel may get saturated and need replacement with fresh chemical, while the saturated chemical may be reactivated for further use.

Commercial dehumidifiers are available for reducing humidity in rooms. The reduction in relative humidity brought about by these machines depends on the moisture content of the atmosphere, the size of the room etc. The temperature of the dehumidified air is slightly raised as it is passed through the machine. At a station where humidity is excessively high, and the use of the machine does not raise the temperature of the

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room beyond comfortable limits for the working staff, it could be conveniently used.

Besides atmospheric humidity, dampness in a room may also increase its humidity. Often defective laying of floors and use of low grade construction materials result in increased dampness in the room due to infiltration of moisture through floor and walls as a result of increase in sub-soil water or heavy rains etc. Therefore, it is necessary that the room selected for records should have damp proof floor. While constructing new record repositories due consideration of the level of sub-soil water is very essential, and special attention should be paid to the materials and laying of floor etc. to make them damp proof.

Since stagnant air, combined with high humidity, accelerates the decomposition of materials and also favours the growth of injurious pests, fresh air circulation in every portion of the record room is very helpful in checking the growth of these pests. An adequate number of windows and ventilators ensures good circulation of air, but at times it may be necessary to circulate the air inside the room with electric fans. Dry artificial heat obtained by the use of electric radiators and stoves is one of the effective means of reducing excessively high humidity in record rooms. Use of such appliances will evidently raise room temperature which in itself may be above the limits already mentioned and is harmful to record materials. This process is hardly applicable in tropical climate except in the hills in winter months and as such it should be adopted with care in such cases It is, however, necessary that documents are not stored in the vicinity of such heaters or radiators.

Storage conditions : record rooms and stack equipment

It has already been observed that dampness not only accelerates decay of organic materials but also provides a favourable condition for propagation of mildew and pests like silver-fish, cockroaches, termites etc. Care is, therefore, necessary to see that the record room is not damp and that its walls, flooring etc., have no crevices. Selection of record rooms and shelving equipment play an important role in preserving records.

Whereas provision of cross windows and ventilators for air circulation is necessary, it is also to be ensured that no direct sunlight finds access to the stored materials. In record offices exposed to too much sunlight it is desirable to provide windows and ventilators with glass panes and screens and keep them closed.

Open shelves are necessary for accessibility of air to the stacked materials. An additional advantage of such shelves is that they facilitate servicing work, which is rather difficult if closed almirahs are used. Iron shelves seem preferable to wooden ones since wood itself requires care and chemical treatment against certain pests, amongst which termite is its most voracious enemy. It is preferable to avoid contact of racks with walls so as to eliminate damp dark pockets where insects breed. For similar reasons shelves made of concrete and supported in walls do not make ideal storage arrangement. The present day trend is to install adjustable metal shelves so that spacing between individual shelves can be adjusted to suit the size and bulk of the record materials.

Injurious pests and their control : mildew

The incidence of mildew or moulds in books and volumes is very common in a hot and humid climate. While moulds include all kinds of organism which grow on paper, leather, textiles, etc., mildew is the term popularly used to designate a variety of vegetable organism among fungi. These micro-organisms grow very slowly at low temperature, 4.5°C (40°F) and rapidly at optimum temperatures, 27-35°C (80-95°F), differing with different speces. At high temperatures, above 38°C (100°F), most of these organisms cannot live. The spores of these species remain suspended in air and can be carried over long distances. Growth of these micro-organisms is usually detected by the presence of brownish to greenish black patches on leather, paper, etc. These species are capable of causing stains on paper, technically known as 'foxing'. It has been found by experience that mildew is common in volumes and books which remain pressed against each other. This is due to the fact that when books are pressed

one against the other, the intervening atmosphere is reduced to a thin flat stagnant air pocket which favours, the growth of mildew. Books and volumes loosely shelved are not generally so mildewed.

Temperature and relative humidity in the range 22-24°C (72-75°F) and 45-55% respectively, check the growth of these species. If regulation of temperature and relative humidity within the above limits is not feasible, the growth of these micro-organisms can be retarded to a considerable extent by maintaining thorough air circulation in the room with the help of electric fans. In case mildew or mould infestation has already occurred in books and volumes, the only means of eliminating it is to fumigate the infested materials with thymol. Thymol fumigation, the details of which are described below, kills but does not remove the organism or any accompanying stain.

Thymol fumigation

A suitable apparatus for thymol fumigation can be made by adapting an air-tight cupboard or box. The volumes to be fumigated are supported some 15 cm. from the bottom of the cupboard on a framework of wire net. A 40-60 watt electric lamp is installed at the base of the cupboard over which thymol contained in a dish is heated. The files or volumes are opened in an inverted 'V' form with the stitched or bound part forming the apex. On heating, thymol vaporises and the closed space inside the air-tight cupboard becomes saturated with thymol which destroys the mildew growth. A concentration of 100-150 gms. per cubic meter is often sufficient, and the time of fumigation varies from six to ten days, the heating of thymol being necessary for two to four hours every day. Records infested with mildew should be first cleaned and then fumigated. The fluffy surface growths can be cleaned with solft cotton wool. Care should be taken to prevent scattering of spores in the process of cleaning.

The sterilization of the atmosphere of the room by spraying a 10% solution of thymol in methylated spirit will check the growth of spores present in a record room where there is no

adequate arrangement for bringing down the humidity below 75% during the rains. Since thymol vapours are pungent, it is advisable to spray thymol solution at the close of the day, since the room and windows can be kept closed overnight.

Insects : cockroaches and silver-fish

Damage done to books and records by insects is often considerable. Perhaps no repository is completely free from the depredations of insects. Cockroaches and silver-fish are two surface feeders which generally damage the outside of the volume, *viz.*, binding fabrics, leather, board, etc. Silver-fish is a tiny insect with glistening silver grey scales. It is frequently found on damp walls in warm and humid climate and feeds upon record materials and textiles. These insects do not multiply rapidly but are difficult to eradicate.

Cockroaches are too well known to need description. They are closely related to grasshoppers and crickets and are dark brown in colour, having two protruding antennae. There are a number of varieties of these species, out of which common household cockroach is omnivorous, exhibiting a marked liking for sweetened and starchy materials. During day they retire to dark and damp corners or rest in crevices, but roam all over at night in search of food.

Under favourable conditions insects multiply very rapidly. Vigilance and preventive measures, therefore, become necessary. As a matter of fact, insects are invariably attracted by edibles which should be forbidden in a record room or library. Avoiding dark and damp condition in the room and filling up all the crevices in walls and floors with cement will eliminate the conditions favourable for their breeding. Use of insect-repellent chemicals like naphthalene reduces chances of insect attack. It seems a good practice to keep naphthalene bricks every six feet or so on the shelves. Complete annihilation of these insects requires the use of poisonous dust powders, D.D.T., pyrethrum, sodium flouride, etc., or commercial spray insecticides. These poisonous powders and insecticidal liquids are sprayed in places frequented by these insects, *i.e.*, dark corners, crevices, walls, etc.

Thymol fumigation

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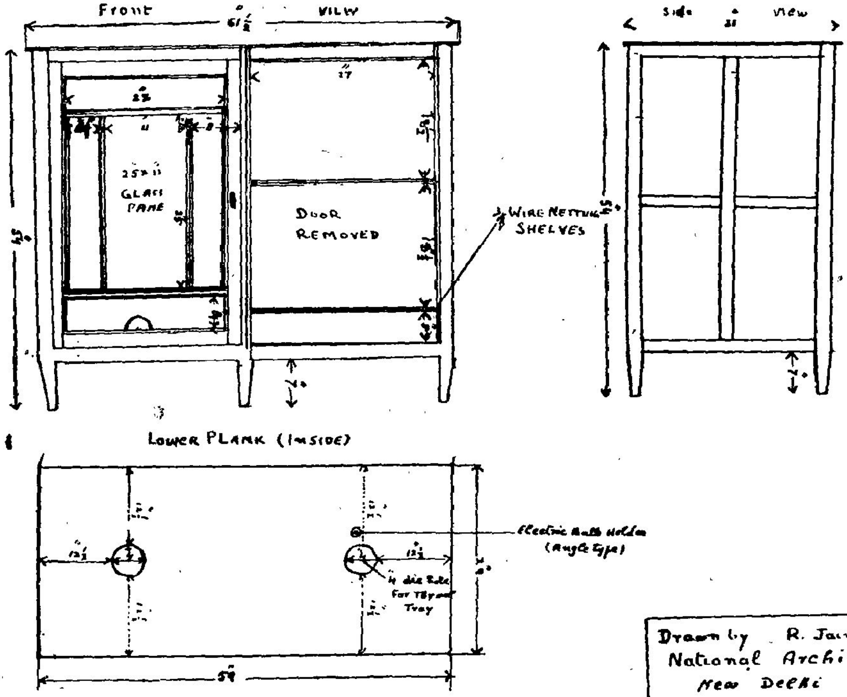
SKETCH OF THYMOL FUMIGATION CHAMBER



Drawn by R. Jain
National Archives
New Delhi
Date: 19.6 1959

While using these poisonous dusts or insecticidal liquids available in the market, care is necessary to ensure that the spray is directed to the walls, dark corners and crevices frequented by the insects, and not to the books and records. Direct spray of these toxic chemicals on records might not only stain them, but also prove harmful to those who handle these records.

Book-worms and psocids

Besides cockroaches and silver-fish, there are other insects like book-worms and psocids. Psocids are commonly known as book lice, and are more dangerous in their damage to record materials than the surface feeders. Since the infestation of these species usually starts in the spine and the joints between the boards of bound volumes, it is difficult to detect them till considerable damage has been done. Gastrallus Indicus, *i.e.,* bookworm or book beetle as it is commonly known, has two stages of development, *viz.,* larvae or grubs and fully winged beetle. The larvae or grubs generally travel from the surface down the bulk of the volumes and cause damage in the form of pinholes and empty parallel sided tunnels, while beetle is the main cause of spreading the infestation to uninfested records.

Fumigation with lethal gases : para-dichloro-benzene and killoptera

The most effective means of getting rid of the infestation is to treat the affected records with vapours of lethal chemicals or toxic gases. Vacuum fumigation with ethylene oxide mixed with carbon dioxide (1 : 9 by weight) is the most effective method of eliminating these dangerous enemies of records. This process of fumigation involves installation of costly equipment and perhaps only the major record repositories can afford it. For small record offices which may not be in a position to afford such expenditure, fumigation with crystals of para-dichloro-benzene or liquid killoptera (a mixture of carbon tetrachloride and ethylene dichloride, 1137 may be adopted. Fumigation may be carried out in an airtight steel almirah, the shelves of which are perforated. Records for fumigation are spread on the shelves and bound books or files opened and kept in inverted 'V' shape with the bound part forming the apex. Paradichlorobenzene is used in a

concentration of 1.5 kg. per cubic metre whereas killoptera is used in a concentration of 225 ml. per cubic metre. Both these chemicals vaporise at ordinary temperature; are heavier than air. These are placed in the uppermost shelf of the fumigation vault. The time of fumigation is for 7 to 8 days when paradichlorobenzene is used and varies from 24 to 26 hours with the use of killoptera. Fumigation with the above chemicals kills living larvae and active beetles, but eggs laid in furrows near the binding joints and in boards of volumes, are not affected. Since there is a possibility of their maturing into larvae in 20-21 days, a repetition of the fumigation process for complete elimination of these species is usually necessary after this period.

Termites or white ants

Another species that is more destructive to records than the insects described above are termites, commonly known as white ants. Among all the insects that damage wood and cellulosic materials, *viz.*, paper, pulp board etc., these are the most dangerous. White ants, which are found all over India, usually build their nests in the ground and extend them into timber work and buildings. They construct mud covered runways over bricks and concrete, have a marked aversion to light and work in concealment. The infestation of this species is usually detected only when their infestation has become severe and considerable damage has been done to the stored materials. Their extreme infestation is indicated by the emergence of a large number of flying termites during rains. A warning that white ants are around, is the branching shelter tubes or mud covered runways on foundation walls reaching from the ground to the wood-work or over the surface of stones, bricks, etc., which these insects cannot burrow.

Killing the live insects visible in the material is of little help since the reproductive rate is astonishingly high in this species. A female queen produces thirty thousand eggs a day on an average. Damage to buildings etc., can only be checked if measures are taken to isolate the building by digging a trench outside the foundation wall, and filling it with chemicals like coal-tar and creosote oil. Extermination of the colony itself is

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also necessary. Such measures for white ant eradication often require considerable experience and have perhaps to be attended to by experts in the line.

The best way to prevent damages to material against the ravages of these insects is to adopt measures that check their emergence in buildings. It is, therefore, necessary that at the very first sign of white ants in a room, all inlets from which infestation might start, *i.e.*, joints, cracks, crevices in the floor and walls, etc., should be immediately filled up with cement and concrete. If the flooring is felt to have been hollowed from places, it should be broken at the hollowed places and filled with poisonous chemicals. White arsenic, D.D.T. powder, 1% solution of sodium arsenite in water or 5% solution of D.D.T., Dieldrex emulsible concentrate with water, 1:60 (4-5 litres per metre), are quite satisfactory for the above treatment. After the treated place has become dry, it should be cemented and flooring made intact. Walls of the room should be examined and treated likewise.

All joints of wood-work in contact with the walls should be painted with creosote oil, at least once in six months if the infestation is severe. In an infested building it is desirable to avoid the use of almirahs built in the walls. If wooden almirahs or racks are in use, they should be kept away from the walls at a distance of 15 cm. at least and the legs of the almirahs or racks painted with coal-tar, creosote oil, or dieldrine emulsion once in six months, treatment being given once before the rains. If possible, the almirah or the rack may be segregated from the infested ground by placing its legs in bowls containing coal-tar or creosote oil. This will raise a chemical barrier and insects will seldom find their way to the record materials. Since this chemicals is corrosive, it should be handled with care. As a precautionary measure the entire wooden structure may also be painted with 20% zinc chloride solution in water.

White-ant infestation may occur in any building constructed at a site infested with these species. Buildings, with improperly laid foundation, defective construction, built with poor materials or damaged by earthquake are susceptible to white ant infestation. Neglect in maintenance may also facilitate the incidence of white ants in a building. Therefore, vigilance in attending to minor damage and repairs, and maintaining tidy conditions of storage will help protect valuable records against damage by white ants. Use of wood of poor quality for construction work, etc., also increases the possibilities of white ant damage to a building. Selection of good quality wood is, therefore, an important factor. Treated timber is available in the market and may be used for this purpose. In the absence of treated timber, hardwood of Indian timber, like teak and *shisham,* may be used. Although racks made of teak or *shisham* wood are reported to be resistant to white ant, yet the use of steel racks is preferable for record repositories and is economical in the long run.

Rodents

Besides the biological pests described above quite often serious problem is posed by physical damage to record materials by common household rats. This small and insignificant appearing animal is very quick in its action and at times in a single night many irreplacable collections have been cut into pieces. Its presence in a building housing valuable records, manuscripts, books, etc. is a matter of concern and the problem needs tackling in a scientific way.

Only eliminatory steps are of little help unless supplemented by preventive measures. Rats often find entry into a building from outside and a great deal of trouble can be saved by preventing their entry into the building. It is in the first instance essential that hygienic conditions are maintained in and around the repository or record room so that conditions that favour breeding of rats are altogether eliminated. Refuse should be kept in metal rat proof tins until removed for disposal. If thrown in open these materials provide shelter, food and breeding ground for rats.

For preventing rats from entering the room used for records, all joints between the partition walls and the main structure should be effectively sealed. Care should be taken to allow no cavities in laying pipes and cables and in constructing ducts. It is necessary to fill in the holes in walls, floors, ceilings, wall joints with concrete mixed with glass powder. All essential openings should be restricted to 8-9 mm only; windows, ventilators etc. should be of close fitting type. Maintenance of drainage and sewer system in a good condition; replacing fresh air inlets, gulley grids, manhole covers etc. by new ones whenever necessary will help a good deal in preventing rats and rodents from entering the building.

Menace caused by rats can be effectively controlled by poisoning and trapping. Poisons are always used with baits which are spread over places frequented by rats. Damps, sausage, rusk, dry ground biscuit mixed with water, sugar meal (nine parts of wheat floor and one part of sugar) oat meal (two parts in one part of water, soaked well and formed into a thick paste) are some of good bait bases. Dry bread and cheese have also been quite effective as a bait base. Some of the good rat poisons are Zinc phosphide (3-5%), Arsenous oxide (10-15%), Barium Carbonate (10-15%). ANTU (Alphanaphthyl-thiourea) and Warfarin (3, Lactonyl-4 hydroxy coumarin) are commercial poisons sold under trade names and can be used. The best way to use baits is in traps. Different designs of rat traps are available. It is, however, desirable for effective rat trapping that the position of the trap, the choice of a bait and poison should be changed at intervals, otherwise once these animals become trap or bait shy they avoid them and trapping becomes difficult.

Susceptibility to damage may be reduced by using rat inhibitors such as Barium derivatives of nitro or chloro phenols, mercapto-benzothiozone, oil of citronella or oil of winter green etc.

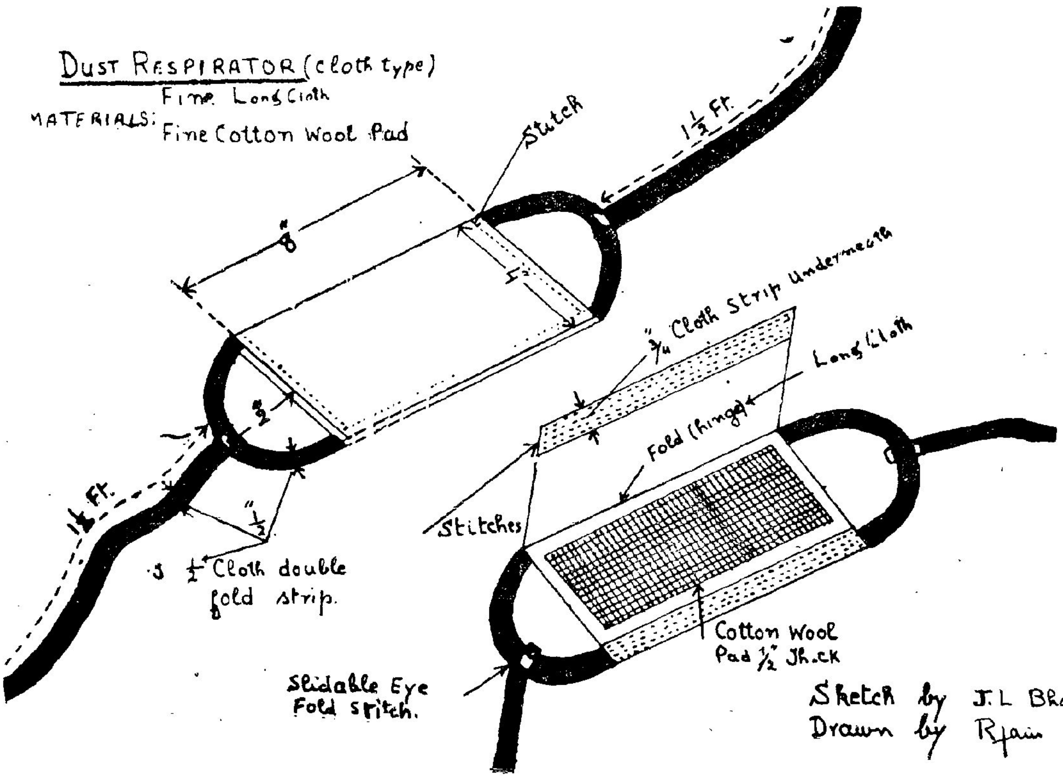
Care to upkeep and storage

Periodic inspection of the record room will help in eliminating the possibilities of insect attack and in maintaining tidy condition in the room. Accumulation of dust, as has been already

Dusting with Vacuum Cleaner

Dust Respirator (cloth type)

MATERIALS: Fine Long Cloth
Fine Cotton Wool Pad



Sketch by J. L Bhatnagar
Drawn by R Jain

discussed, creates favourable conditions for the growth of injurious pests, and is unhygienic for the persons who handle these materials. Besides containing hard siliceous particles, dust contains organic particles from the putrefied record components which might be containing bacteria harmful to human beings. Regular dusting with the help of electric vacuum cleaners is a vital need for every record office. Ordinary dusting with cloth pieces makes the dust particles float in the room without removing them from the repository and is unsatisfactory. Staff attending to dusting should preferably be provided with dust respirators to safeguard against the injurious dust particles. A cloth bag with cotton lining works as a satisfactory respirator. Cobwebs on walls, ceiling etc., should also be cleaned periodically.

Carton boxes of requisite size and sturdy make are suitable for keeping files and docketed documents, especially laminated documents. However, in the absence of carton boxes which are ideal for the storage of records, files should be tied between two pieces of 5-ply vanista boards of size slightly larger than that of the files. This will avoid their warping due to variation in temperature and humidity. The boards containing the files should be tied near both ends with loglines which should go round at least twice. If only one end is tied, there is unequal pressure on the two ends of the files which may result in their subsequent damage. While tying a bundle care should be taken that the logline does not cut into the edges of the files. The bundles should be kept on the shelves preferably horizontally. However, if these are kept vertically, care should be taken to ensure that the bundle is upright, there is no leaning of the bundles against each other, and that the ends of the files do not get curved under pressure. If the shelves are supported in the wall, bundles near the wall ends of the shelf should be kept at least 15 cm. away from the wall.

Care in handling

Records should be handled with care. All endeavours for proper preservation and storage will be in vain if care is not observed in handling the bundles of files or an individual file.

While removing the bundles from the shelves, these should not be dragged out from their places. Instead, these should be lightly lifted with both hands, care being taken that the other bundles are not disturbed. The bundles should not be thrown on the table or floor but should be placed gently. The file should be taken out after untying the bundle and in no case it should be dragged out. After the required file is removed and a slip provided for the file, the bundle should again be properly tied and restored on the shelf.

Neglect of a few simple precautions sometimes results in irreparable loss through fire accidents. Smoking should be strictly prohibited in the record room and any type of open fire should also be forbidden. All electric wires should run through conduits. No chemicals should be stored in the record room Necessary fire fighting equipment, preferably of the gas type, should always be at hand.

II. ESSENTIALS OF A RECORD ROOM

The custody of non-current and semi-current records is the responsibility of every office and department. Quite often for want of proper storage accommodation the bulk of the recorded files remain neglected. These are often relegated to corners of rooms, the corridors and basements, badly exposed to dust, damp and insect pests. For long term preservation of records it is imperative that a suitable storage area is selected in the first instance. Further with reasonable care and maintenance the deteriorative influences which are otherwise speeded by hard usage and neglect, are slowed down considerably.

Physical security of records is primarily dependent on the storage environments, the manner of their storage and the care deployed in their handling and upkeep. The various factors that need consideration from this aspect are:

The location and the design of the storage room; the equipment available for, and the manner of the storage; storage environment, facilities of handling and servicing the materials; and the steps adopted to safeguard them against fire hazards, floods, etc.

Location and design of the Record Room

While considering the location and design of the record room, the nature of the holdings, their bulk, working and functional requirements, security aspects, and the rate of annual accession of records are very important factors that have a bearing on the selection of a specific room for record storage.

A separate record room or a storage area is vital necessity for every department having independent administrative set up. The room as far as possible be located in the ground floor of a building or its basement. Quite often the water inlet pipes or out drains are present in the basement and make them damp.

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To prevent such a situation it may be ensured that no water pipes or drain pipes pass near, above or under the record room. Further to prevent any inflow of water to the record room due to blockage of drains, accidental pipe bursts etc., the floor level of this room should be raised a few centimetres above the general level of other adjacent floors in the building. This floor can then be connected with other floors by providing a suitable ramp near the entrance for facilitating trolley movement.

Besides catering for adequate storage space, the room should have enough accommodation for record reference and reception.

Storage environment

For long term preservation of records there has to be an elimination of climatic factors responsible for deteriorating influence on record materials *viz.*, temperature, humidity, light, acidic gases etc. It virtually means that an artificial atmosphere has to be created in the record room which is excluded from outside environments. Air conditioning of the record room is the only answer for such a purpose. Depending upon the resources central air-conditioning or package type air-conditioner may be installed for this purpose. Optimum conditions desirable for prolonging life of records have been described in earlier chapter.

Air-conditioning involves considerable expense. Inspite of the fact that the expenditure is definitely justified in the extreme climatic conditions of the tropics, most organisations may not be able to meet the cost of installing, running and maintaining an air-conditioning system. A way has to be found to achieve favourable conditions of rooms by using appropriate building and construction materials or by redesigning or modifying the present architectural design.

Primarily the room selected for record keeping should have adequate ventilation for good air circulation, which if need be, could be augmented with aircirculaory devices. Air circulation helps eliminating pockets of stagnant air which coupled with excessive humidity result in growth of micro-organisms and other

injurious pests. Use of mechanical devices like dehumidifiers or chemical dehydrants as mentioned in previous chapter help a lot in keeping the biological agents under control. Further the effect of temperature can be kept within reasonable control by choosing such rooms which are in the interior or have a covered corridor outside. The use of heat reflectance paint on the roof and outside walls also help in reducing the effect of high heat. It is well known that the roofs & walls get sufficient isolation if number of closed outer bounds be placed as high as possible in relation to the openings. The destructive effect of light can be reduced by favourable orientation of the windows, by constructing sun breakers by using sun reflectors or special glass panes.

The effects of temperature and humidity created by plants or artificial lakes often come to a great help in taking advantage for the creation of artificial environment in a building.

While considering air-conditioning of the record room, which has to be planned for working clockwise throughout the year, the bulk of shelving, their arrangement volume of records moving in and out has to be taken note of. For an effective air-conditioning the number of openings in the room have to be minimum and it is also necessary that the air-conditioning portion be properly insulated from the non-conditioned adjoining areas. It is also desirable to see that permeation of dampness through the walls or floors does not take place. Laying water proof floors, painting the walls with oil colours are some of the desirable treatments which are of good help. Defective air-conditioning and its occasional breakdown results in rapid damage than that which would otherwise result by storing these materials in ordinary climatic conditions with proper care.

Shelving and storage equipment

One of the preferential requirement of a shelving system in a record room is the availability of the maximum storage density. Whereas the shelving provided in a record room should be functional and durable, it should be so arranged that it is easy to clean and offers maximum protection to records. The design

of the record room to a large extent determines the arrangement of racks, their placement, height etc., the length depends on the dimension and the orientation of the room.

Shelves should be fixed away from the walls on upright fixers equidistance throughout the storage area. Distance between successive rack rows may vary from 0.71 to 1 M with a central gangway of 1.5-2 M or in accordance with requirements laid down in "IS" : 2663-1964 Code of Practice for the Basic Elements in the Design of Buildings for Archives". Distance between the successive row of shelves (shelf height) and its depth may depend on dimensions of records/files and the manner of keeping the record series. A perusal of Indian Standard Code referred to above will be helpful.

If steel shelving is provided it should be painted rust proof. The paint should be stable and non-injurious to documents. Steel shelves may preferably be slotted for vertical free circulation of air. Where wooden shelves are provided the wood should be protected against termite infestation. Use of chemically treated wood is desirable for fabricating the wooden furniture for the storage of records. Sharp edges and corners in the shelves and supports, which can result in physical damage to documents should be rounded off. Besides providing above mentioned advantages the shelving system should also provide maximum facility and convenience for reference and servicing.

Collections in record rooms differ in bulk, size and shape and commonly consist of bound volumes, loose sheets, files, manuscripts, maps, charts, plans and drawings. Shelving arrangement needed for specific materials need designing according to the nature, shape and bulk of the material. While designing these shelves it may be ensured that neither these nor the materials kept on them touch either the walls, ceiling or the floor. The distance from wall, ceiling and floor should be at least 15 cm.

The records should be loosely packed on the shelves to enable free air circulation and preventing pocket of high humidities. Files may be kept either tied in bundles with stiff support

on either side or in carton boxes specification of which have been described in earlier chapter. For servicing of records from upper shelves not within reach of human height use may be made of step ladders or platform type ladders. Movement of records from the record room is facilitated with the use of trolley with swivel castors.

Maintenance of tidy conditions, periodic and regular cleaning arrangements, use of preservative chemicals and constant vigil against damage by insect pests is necessary for safe maintenance of these collections. Such measures as will ensure longevity of record materials have been dealt with in earlier chapter, and if kept in view, will be helpful.

Safeguard against fire hazards and other security arrangements

To protect against any accidental fire, all electric wiring should be through conduits and the main control switches of lights etc. installed in the storage area should be located outside the Record Room. As far as possible the Record Room should be made fire resistant. In big Record Rooms the storage space should be divided into separate fire resistant compartments and additional automatic dampers should be installed in the centrally airconditioned ducts to ensure the immediate closure and thereby preventing the spread of fire to other compartments. It is advisable to provide emergency exists besides the main entry door to the record room to remove valuable records to safety. Every record room should be fitted with a fire detection alarm system to detect any fire in the storage area. Use of naked light, heaters and smoking in the room should be prohibited. As a preventive measure against accidental fires, all light and power circuits should be switched off after office hours. Watch and Ward staff provided for this area may use torches if necessary. Use of temporary lights, loose and ordinary flexible wire for fans, air-circulators and other electrical appliances for the repository, should be avoided and instead 'Workshop Braded and Armoured' flexible wire should be used. Electrical appliances and fittings in the repository should be periodically checked for loose connections and defects rectified.

For combating fires, adequate equipment of carbon dioxide (CO_2) type should be provided at suitable places in the building for easy accessibility. Besides, water pipes and hoses should be installed at convenient points to fight any major conflagration.

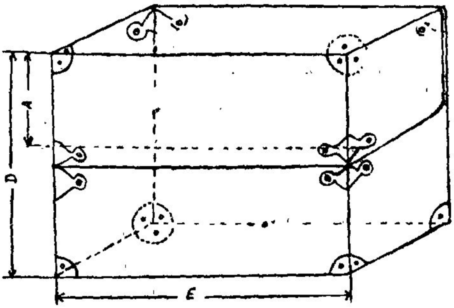
All the equipments for either detection of fire or combating fire should be checked at regular intervals to ensure their being in active operative state at all times. Similarly, staff connected with the storage of records should be trained in fire fighting. A fire drill may be arranged at least once in two months to keep the trained staff alert.

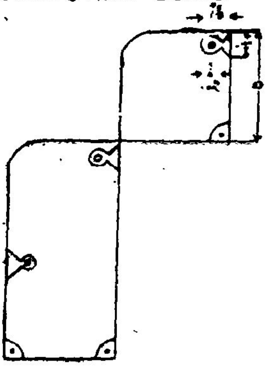
Instructions regarding prevention of fire and fire fighting in case of fire for the common man should be prominently displayed in the Record Room. Likewise telephone number of the 'District Fire Service' for contact in emergency should be prominently displayed at a central place in the record room. It will help seeking quick aid of the expert fire fighting agencies whenever exigencies so demand.

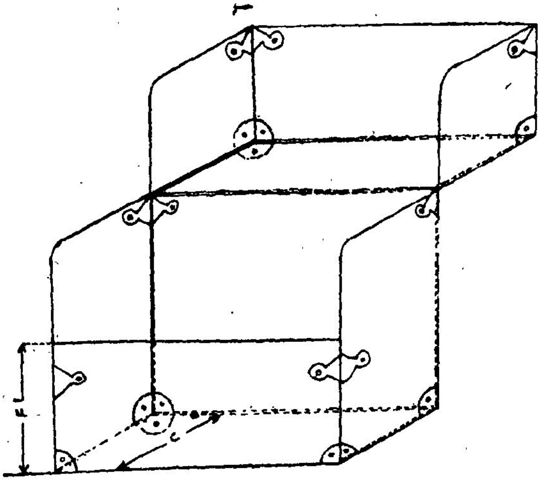
The windows of the room that open into the space outside or in the courtyard in the interior, should be fitted with metal grills and net of expanded wire metal. To ensure that there is no splashing of rain water into the room, rain shades should be provided at all these openings. For reasons of safety and security it is advisable to permit limited entry into such rooms.

Diagrammatic Sketch of Document Container

Material. Strong Compressed Straw Board







A . $5\frac{1}{4}$"

B . $6\frac{1}{4}$" (MINIMUM)

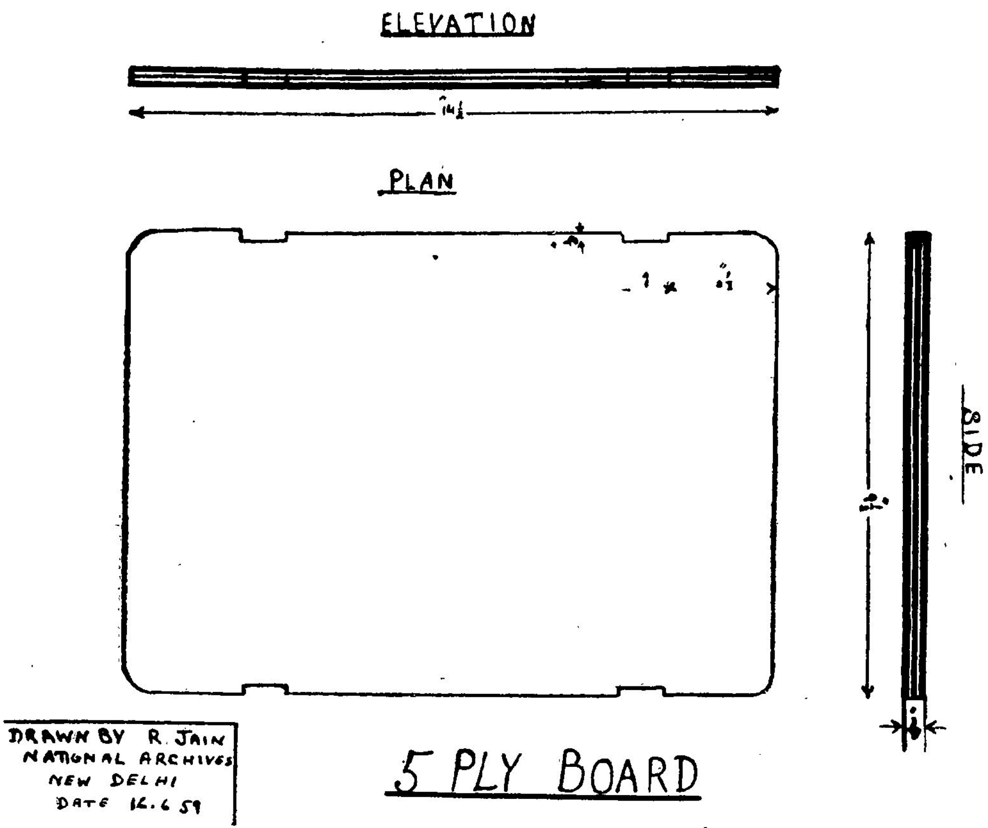
C . $6\frac{1}{4}$" (INSIDE)

D . $12\frac{1}{4}$" (INSIDE)

E . 16" (INSIDE)

F . 7" (INSIDE)

Drawn By R Jain
National Archives
New Delhi
Date . 16.6.59


ELEVATION
14½
PLAN
SIDE
9½"
DRAWN BY R. JAIN
NATIONAL ARCHIVES
NEW DELHI
DATE 16.6.59

5 PLY BOARD

III. DEACIDIFICATION OF PAPER

Sudborough and Mehta made a study of the perishing of paper in Indian libraries and observed that degradation of acidic paper is difficult to arrest. Extensive investigations into the causes of deterioration of paper of the eighteenth and nineteenth centuries, carried out by W. J. Barrow, also confirmed that nearly all the deteriorated papers were highly acidic. Even if ideal storage conditions, *viz.*, temp. 22-25°C, and relative humidity 45-55 per cent are maintained in the record repository, gradual weakening due to the inherent acidity goes on. The acidity in paper is attributed partly to the treatment rendered to the pulp in its processing, and partly due to absorption from the environmental atmosphere and migration from acidic material in contact. Acidic nature of ink used for writing also contributes appreciably to the weakening of paper.

Treatment to counteract residual acidity in paper prior to repair is thus desirable. The process of neutralising acidity in documents, advocated by Mr. Barrow, is widely adopted. It consists in treating the papers with solutions of calcium hydroxide and calcium bicarbonate. By this treatment not only the acidity is effectively neutralised, but a small amount of calcium carbonate is precipitated in paper. The calcium carbonate so precipitated has an inhibiting effect on compounds causing degradation of cellulose, and also counteracts subsequent deleterious influence of absorption of acidity during storage.

Barrow's deacidification process

The procedure of Barrow's deacidification process as followed in the National Archives of India is as under: —

Three enamelled trays containing calcium hydroxide (0.15 per cent), fresh water and the calcium bicarbonate solution (0.15 percent) are taken. Since the documents are to be immersed completely in all the three trays, the size of the trays should be larger

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than that of the largest document needing treatment. Each paper to be deacidified is placed on a waxed paper larger than the document (stainless steel wire frame of the appropriate size could also be used), and both immersed in the tray containing calcium hydroxide solution. Depending upon the depth of the tray (2.5 to 6 cm.) 5-10 sheets can be immersed in one operation. After 20 minutes, the sheets are removed, excess of calcium hydroxide drained, and the sheets immersed in fresh water for a couple of minutes and then immersed in calcium bicarbonate solution for 20 minutes. Afterwards they are again placed in fresh water to remove excess of calcium bicarbonate. During the treatment of the sheets in different baths it is necessary that the solutions are agitated lightly by raising and lowering the ends of the trays. The treated papers are finally pressed in pads of blotting paper and left on the racks for drying, care being taken that the sheets are not disturbed during this process. 1000 cc. of each solution will generally suffice for 10-15 sheets of foolscape size.

Preparation of deacidifying solutions

Calcium hydroxide and calcium bicarbonate solutions are prepared as follows:—

(i) Calcium hydroxide solution (Solution I)

To about half a kilogram of good quality, well powdered calcium oxide 2-3 litres of water with light stirring are gradually added in a 5-8 litres glass jar or enamelled container. Constant stirring and gradual addition of water result in formation of a milky cream. During this process considerable heat is evolved and care should be taken that the mixing is slow and uniform. After 10-15 minutes the contents of this container are transferred to an enamelled or porcelain jar of 25 to 30 litres capacity. Water is then added with constant stirring till the volume of the solution is 25 litres. After the excess of the lime has settled at the bottom, the clear liquid is drained off and is rejected. This will get rid of suspended impurities if any in the lime, and pure lime will remain in the jar. 25 litres of water are again added and the solution well stirred. The lime in excess is allowed to settle and the drained liquid which is a milky

suspension is used for deacidification. After the solution is drained, again 25 litres of fresh water are added to the container with stirring. The drained liquid is again used. In this manner the same lime can be used for preparing calcium hydroxide solution 15-20 times.

(ii) Calcium bicarbonate solution (Solution II)

This solution is prepared by taking about ½ kilogram of finely powdered calcium carbonate in a 25-30 litre enamelled or porcelain jar and passing carbon dioxide gas through the solution for 15-20 minutes. During the time the carbon dioxide gas is passed through the solution, the solution is kept well stirred. This roughly gives a solution of calcium bicarbonate of requisite strength.

Alternatively the solution can be prepared by passing carbon dioxide in a solution of calcium hydroxide in water. At first a milky suspension of calcium carbonate is formed. On continued passing of carbon dioxide it changes to clear solution of calcium bicarbonate. Therefore the clear solution of calcium hydroxide obtained from Solution I is taken and diluted to twice its volume. Carbon dioxide gas is passed through it with constant stirring till the white precipitate of calcium carbonate again dissolves to give a clear liquid. About 30 litres of the solution may require 30-48 minutes of gas treatment for giving the requisite solution.

Neutralisation with ammonia gas

Treatment with calcium hydroxide and calcium bicarbonate solution is applicable only in those cases where the ink on documents is not washable with water. In cases where it is felt that the ink might smudge or get smeared by contact with water, it is possible to deacidify the documents with diluted ammonia fumes. In this process the documents to be deacidified are either hung in line in a steel cabinet or spread on perforated shelves such as those of the steel vault described for para-dichloro-benzene fumigation. Diluted ammonia (1 : 10) is placed in the bottom of the vault or steel cabinet and the documents left for 4-5 hours. After exposure to ammonia fumes the treated

papers are exposed to fresh air for 10-12 hours to dispel excess of ammonia in the documents. The process, however, needs very careful and controlled operation. While carbonaceous and other similar varieties of water soluble inks are not affected by ammonia treatment, certain dyestuff inks may get damaged. Before subjecting documents to treatment by this process, it is essential to test the effect of ammonia on the ink used.

Stabilization of printed paper with calcium and magnesium

Besides the above treatment for deacidifying paper, Barrow has recently recommended treatment of all printed papers (papers having wood fibre as a constituent) with a solution of calcium and magnesium bicarbonates. The solution for treatment is prepared by passing carbon dioxide for 2 hours in a mixture of 1.5-2 gm. of calcium carbonate and 15-20 gm. of magnesium carbonate in 1 litre of water. After the undissolved particles have settled the clear solution is decanted and used for treatment purposes. The papers needing treatment are soaked in the above solution overnight after which the excess solution is drained from the papers which are then dried. Calcium and magnesium bicarbonates absorbed in paper get converted into insoluble carbonates which inhibit the deleterious influence of acidic constituents on cellulosic fibres.

Use of magnesium bicarbonate alone has been also studied by Barrow for deacidification and stabilization of paper, and since the deacidification or stabilization in solution form is applicable to strong and physically sound papers, a process of spray deacidification has been developed. Spray solution is prepared by passing carbon dioxide through an aqueous solution of magnesium carbonate (25 gm./1 litre) for 2 hours. Electrically operated spray painting gun can be used.

Chiemical inhibitors such as disodium pyrophosphate has been also found successful for inducing buffer action. The inhibitor solution is made in water and impregnation is carried out

just in the same manner as in the case of alkaline deacidification. The following inhibitor solution has been suggested by Langwell:—

Disodium pyrophosphate	42 gm.
Potassium Ferrocyanide	4.7 gm.
Sodium carbonate crystal (washing soda)	14 gm.
Water	4.5 litres

In case paper to be so treated needs resizing, 84 gm. of glue or gelatine may be added to the inhibitor solution.

Besides deacidifying documents, the alkaline treatment as suggested above has one additional advantage. All the slips and other minor repairs that might have been done can be easily removed from over the document in an alkaline bath, the residual paste etc. on the document is washed off, and the document is well cleaned for subsequent reinforcement. However, as has been mentioned earlier, all these processes need careful handling of the document and proper control of the various operations since slight inattention may result in damage.

IV. REHABILITATION OF OLD RECORDS

Records as they arrive at the repository for storage are sometimes in a dilapidated condition, and require minor repairs etc., to put them in a proper condition for facilitating subsequent handling and storage. Besides such care, records which might have been spoilt due to exposure to unfavourable climatic conditions and damage by insect pests also need attention.

Flattening and minor repairs

The edges and corners of papers in a file when it comes to the record room may be folded and slightly damaged due to improper tagging of the papers in the file cover. File covers themselves are at times torn and damaged, and need replacement. Therefore, before a file is restored for storage on the shelf, all such minor damages as would subsequently result in major ones should be attended to. However, before the files are unstitched for flattening and minor repairs of the individual sheets it is necessary that they are paginated, so that the order of the file is kept undisturbed when the sheets after flattering and repair are restitched into files.

The edges of paper which might show crumpling tendency should be flattened. Use of moderately hot electric iron is satisfactory for the purpose. The portion to be flattened should be made damp with a wet sponge, covered with blotting paper and ironed. If there are creases in the paper these should also be removed by ironing. If there are minor tears they should be repaired by passing strips of good quality hand-made paper (all rag) at the back of the torn portion. If the portion where the tear exists is written on both sides it could be mended by pasting strips of thin tissue paper on both sides of the tear. Torn and damaged covers could also be mended likewise, or replaced with new covers. In most of the papers the damage is usually confined to the edges of sheets. Such damaged portions may also be

reinforced by pasting slips of all rag hand-made paper, care being taken that if there is writing on the back, the same is not covered in the mending process. The slips should be uniform in breadth, and for most of the minor repairs slips of 1.5 to 2 cm. breadth will be quite satisfactory.

While selecting adhesives for repair work, use of gum or glue should always be avoided. Both the above materials swell in water and shrink on drying. Binders paste prepared with *maida* to which some copper sulphate (2-3%) has been added is quite satisfactory for the purpose. *Maida* paste when kept for 2-3 days tends to develop fungus and often loses its adhesive properties and, therefore, it is advisable to prepare fresh paste when mending is to be done. If tissue paper is used for repair, dextrine or thin starch paste should be used for maintaining legibility of the writing. Preparation and formulae of the dextrine paste and starch paste are given in Appendix IV.

Docketing

After the individual sheets have been attended to for minor repairs, these should be properly put in a thick docket cover and sewn. The size of the cover should be slightly larger than the size of the document. If there is not enough margin on the document for sewing purposes (the writing may be extending upto the margin), a flap of 2.5—4 cm. breadth may be pasted along the margin. The process of flapping is technically known as guarding. The length of the guard should preferably be equal to that of the document. Use of all rag hand-made paper or good quality writing paper is preferable for making guards or flaps. One advantage in guarding is that the individual sheets can be made into pairs or sections and sewn to the cover through the folds of the guard. After the subject matter of the file and is number are recorded on the cover, it is ready for storage.

Other repair processes

Paper in many records might have become so much creased, folded or fragile that it needs reinforcement for its preservation. Processes of repair to be adopted for a particular document will

depend on the condition and form of the document to be preserved. The method of repair adopted in a record office are full pasting, tissue repair, chiffon repair and lamination. Lamination of documents with cellulose acetate foil carried out in a flat bed or rotary press with the application of heat and pressure is the most modern method of reinforcing brittle documents. In the National Archives of India tissue paper is invariably incorporated for strengthening the document during lamination. Since the initial cost of installation of a suitable laminating press and its accessories may run to over one hundred thousand rupees. such a press may not be within the means of every record office in India. Using acetone as a solvent, documents can be repaired by hand with cellulose acetate foil and tissue paper on a limited scale *without any mechanical equipment.*

Full-pasting

Brittle documents which are written on one side may be strengthened by pasting all rag hand-made paper at the back. Before this is done all slips etc., which might have been pasted at the back of the document, should be removed. For this purpose the document should be placed in between two oiled or waxed papers, and immersed in lukewarm water for half an hour to an hour when the paste or adhesive in the pasted slips will become softened and the slips can be peeled off easily. While immersing the document in water care is necessary to ensure beforehand that the ink does not get washed. If the ink shows spreading tendencies when in contact with water, the document should never be immersed in water. In such a case the pasted slips could be dampened by placing over them wet blotting paper slips of the same size. After the paste becomes soft the slip of paper should be peeled off and all rag hand-made paper should be pasted over the document. The size of the paper for full-pasting should be slightly larger than the size of the document to be pasted over. The paper to be used for pasting is immersed in water and spread on a table with a glass top or, if a wooden table is in use, on a waxed or oiled paper, smoothened with a soft cloth piece, and then rolled lengthwise.

The document which is to be reinforced is placed face down on the oiled paper and a coat of starch paste applied with a brush. The rolled hand-made paper is then placed on the edge of the document and unrolled on it, the unrolled paper being pressed simultaneously with a dry piece of cloth or cotton swab. The pasted document is then removed from the oiled or waxed paper and allowed to dry under pressure with reinforced side downward. The oversize hand-made paper is then trimmed with a pair of hand scissors to the size of the document, keeping a margin of 2-3 mm. all round to safeguard the edges of the document when in use.

Chiffon repair

Chiffon or fine transparent silk gauze is used for repairing extremely fragile, ink corroded or insect damaged documents. Before undertaking repair with chiffon all the slips and patches pasted on the document should be removed as described before. After removal of the patches the document which is ready on a waxed or oiled paper is covered with a chiffon or silk piece slightly larger than the document, and dextrine paste is applied to the chiffon piece with a brush starting from the centre and spreading outwards. When the entire document has been so covered and treated with the paste, the assembly is turned over on another waxed or oiled paper. The first oiled or waxed paper which will be now on the top is carefully removed so that the document remains intact on the second oiled or waxed paper. The process of pasting of chiffon piece is now repeated on the top side. After the chiffon has been fixed on both sides of the document, care being taken to avoid creasing of the fabric, the sandwiched document is allowed to dry. The semi-dried document enclosed in between two waxed or oiled papers should be kept pressed in a hand press or between two hand boards with weights over them. After the documents have been pressed these should be removed from oiled or waxed paper, edges of protruding chiffon trimmed, and the documents stitched and docketed as described earlier.

In case the ink of the documents is soluble in water they should preferably be repaired by hand lamination process. If

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such documents are to be repaired with chiffon the process adopted should be as follows: A piece of chiffon, larger than the document, is spread on the waxed or oiled paper and dextrine paste applied to it with a brush. The document is then spread gently over the chiffon and pressed under a waxed paper. Another piece of chiffon of the same size as the first one is again spread on a waxed or oiled paper and dextrine paste applied to it as in the first case. The document to which chiffon has been applied on one side is taken off from the waxed paper and the untreated side of it placed on the paste-treated chiffon, and pressed under a waxed paper. The waxed paper on the top is removed wtihout disturbing the sandwich which is then allowed to dry. The document may then be treated for subsequent processes as described earlier.

Tissue repair

Documents, writings on which have not faded and which show only slight deterioration can be reinforced with fine quality tissue paper. Only unsized imitation Japanese tissue paper, free from oily and waxy constituents, should be used. The sheet to be reinforced is spread on a waxed or oiled paper and dextrine paste is applied to it in thin layer. Tissue paper larger than the document in size is placed on one side of the document and spread lightly from one edge of the document to the other, the tissue which comes in contact with the document being simultaneously pressed with a wet cloth or cotton swab. The other side of the document is similarly treated.

If dextrine paste is not available, thin starch or *maida* paste can also be used for chiffon or tissue repair.

Lamination

The National Archives and Records Service, Washington, U.S.A. developed the process of sealing the documents between two sheets of cellulose acetate foil by application of heat and pressure and for this purpose installed a prototype flat bed hydraulic press. In a similar machine installed in the National Archives of India there are 6 plattens (61 × 81 cm.) hollow from

inside, and providing five openings each 7.5 cm. wide. Five plattens move with the help of a piston under hydraulic pressure. Steam for heating the plattens is produced by an oil-fired boiler and fed at 7-8 kg./cm^2 pressure. Both the temperature and pressure in the pattens are suitably indicated in the control panel fixed to the press. Cooling of the plattens is effected by circulation of water.

Tissue paper is incorporated during lamination to give added strength. To prepare an envelope for lamination, a sheet of of tissue paper is placed on a table, and a piece of cellulose acetate foil of the same size is spread on it. The sheets to be laminated are placed over the cellulose acetate foil in a manner that enough margin is left on the binding side of the documents for having a guard flap, while there is an equal margin on all the other edges for trimming. In case of books and volumes the sheets are arranged in such a manner as to provide ready sections for binding after lamination. The relative position of the sheets is secured by a little application of acetone on the four corners of each sheet. Cellulose acetate foil and then tissue paper are again placed over the document. The corners of the formation are again touched with acetone so that the sandwich may not get disturbed during its transmission to the press. The envelopes are placed in beween two sheets of teflon cloth (tetra flouroethylene coated glass fabric) and two such envelopes are placed between two metallic sheets (chromium plated stainless steel caul plates, thickness of caul plates being 1 mm.). Similar compositions are placed on all the plattens and the press is operated, *i.e.*, the plattens are subjected to hydraulic pressure and heated. Temperature required to melt cellulose acetate is 145°-155°C and is achieved by steam under pressure of 7-8 kg./sq. cm. or more. The pressure needed for satisfactory lamination depends upon the nature of the documents. Normally pressure in the range of 30-50 kg./cm^2. is adequate and the entire cycle takes 10-15 minutes. After the plattens are cooled by circulation of cold water, the pressure is released. The caul plates are removed and the repaired sheets taken out and trimmed, leaving a margin of approximately 3 mm. all round.

Since the documents are cooled under pressure no curling takes place on removal from the press. In order to have satisfactory adhesion all along, documents in one envelope should have the same thickness. Slight variation of thickness is taken care of by teflon cloth and to further ensure uniformity of pressure all over the documents while in the press, two sheets of thick blotting paper are placed on either side of the teflon sandwich before placing it between the caul plates.

A rotary laminator developed by W. J. Barrow consists essentially of two electrically heated thermostatically controlled metal plates for preheating the material to be laminated, and two revolving calendar rolls with a pressure range from 20-200 kg/sq. cm. to supply the necessary compression. The process of lamination consists in placing the documents between two sheets of cellulose acetate foil having two pieces of tissue paper on the two extremities and laid in a moulding form made of thin cardboard lined with tracing cloth which acts as a conveyor during the process of lamination. The complete lamination cycle requires only thirty-five seconds. After the document has been sealed, it is pressed between cardboards and kept overnight under pressure to eliminate any tendency to curl. The pressure by rollers eliminates any possibility of entrapping air between the document and the foil which occasionally occurs with flat bed machines. The machine also has advantage of operating only on electricity and no additional equipment for supply of steam under pressure is necessary.

Lamination offers a number of advantages over other repair processes. The process can easily be applied to documents written with water soluble ink or colours without fear of their spreading. In this regard a word of caution against use of roller type machines where foils coated with adhesives are applied to documents, is called for. Even if the foil used is cellulose acetate, the adhesive may have deleterious effect on record material.

Hand lamination

A modified technique of lamination which does not require elaborate and expensive equipment was developed by O.P. Goel

in the Research Laboratory of the National Archives of India in 1952. This process does not make use of heat and pressure but cellulose acetate is turned semiplastic by acetone and on drying this forms a bond between tissue paper and document. The document that requires reinforcement is placed on a polished glass plate, and a sheet of cellulose acetate foil is placed over the document and a sheet of tissue paper is spread gently over the cellulose acetate foil covering the document. The size of cellulose acetate foil and tissue paper should be slightly larger than the size of the document. A cotton swab dipped in acetone is gently rubbed over the tissue paper. Small quantities of acetone from the cotton swab penetrate the tissue paper and reach the cellulose acetate foil which becomes semi-plastic and on drying binds the tissue with the document. Care, however, is taken that the cotton swab is only lightly pressed, otherwise excessive quantity of acetone will be released and dissolve the acetate foil completely at places, which will subsequently show as patches on tissue paper. The reverse side of the document is likewise treated and the document dried under pressure. Instead of tissue paper, chiffon may also be used.

The hand lamination or the solvent lamination not only offers decided advantage for institutions where expensive mechanical equipment cannot be installed but also provides the only means of laminating documents with seals which would be obliterated under pressure or those written in inks which are liable to decomposition under heat.

Some Special Problems

Repair of maps and charts

Maps and charts more than double foolscap in size are reinforced by mounting them on *malmal* (muslin) or longcloth. The mounting cloth is moistened in water and stretched on the table and fixed to it with thumb tacks. The map or chart to be mounted is cleaned and flattened. It is placed face down on a waxed or oiled paper and paste is applied to its back. It is then transferred from the oiled paper to the stretched cloth and pressed.

The piece of cloth used for mounting should always be a few centimetres larger than the size of the map or chart to be reinforced. The mounted map is allowed to dry in taut condition. When dry, the surplus portion of the backing cloth is trimmed, keeping a margin of 4-6 mm. all round which is then turned back and pasted. This protects the edges of the map.

Charts and maps that are to be stored flat or in rolls are mounted in one piece, while those that must be folded are cut before *mounting along the fold lines. This is known as* "sectioning." The individual pieces are mounted in proper positions on a single piece of muslin or long-cloth, leaving spaces of 1.5-2 mm. between the individual pieces, depending on the thickness of the paper and the number of folds.

Maps and charts can be laminated in the press, using muslin for support at the back in place of tissue paper. Tissue paper is also not used on the face of the map, but two or more sheets of acetate foil may be added instead. Oversize maps can be laminated in sections to the size of plattens and sections joined together by using *muslin and cellulose acetate strips at the joints* using acetone as in hand lamination.

V. BINDING

After individual sheets of a file, manuscript or rare book have been attended to for minor repairs or major reinforcement, as described in the previous chapter, they are compiled and stitched into a docket. If the file is bulky and contains, say, more than 100 pages, ordinary stitching in docket cover does not provide sufficient protection against handling and use. In such cases it would be worthwhile to bind them. The performance of binding, i.e., the ease with which a volume can be opened and closed, and the protection which it affords to the inner sheets depend on the binding processes, while its durability depends on the quality of the materials selected for binding.

Binding processes

More than a dozen processes combine to produce a bound volume, and the recommendations contained in the Indian Standard Code of Practice for Reinforced Binding of Library Books and Periodicals (IS : 3050-1965) hold good for archival bindings. In addition, guarding of sheets and filling up get-in-paper in between the guards after the guarded sheets are gathered into sections, are necessary before these are prepared for stitching.

Guarding and gathering

In order to obviate stitching through the original sheets of a file, manuscript or rare book, as well as to reduce the possibility of damage during this process, individual sheets are tipped in pairs on guard as described under docketing. While guarding sheets for a volume care is necessary to see that sheets fall in right sequence. It is usual to make gathers or sections of 16 pages with 6.25 cm. wide guards. The following procedure facilitates correct order of sheets and produces a straight edge.

Guarding

The outline of the guard strip is marked in the centre of work table with pencil, and then the outline of the sheets to be guarded is marked on both sides, after allowing approximately 5 mm. overlap on either side of the guard paper. The eight leaves of the first gather, *i.e.,* pages 1, 3, 5, 7, 9, 11, 13 and 15 and a waste sheet are placed one over another in a step ladder formation, providing a margin of nearly 5 mm. between the respective sheets for tipping. Binder's paste is then evenly applied with a brush over the marginal step formation, thus giving a streak of paste 5 mm. or so in width on all the sheets. The blank sheet is then removed. Pages 15, 13, 11 and 9 are removed in formation without disturbing the rest, and kept aside. The guard strips are then fixed over the edges of pages 1, 3, 5 and 7 respectively. After the guards have been pasted these sheets are turned over and placed on the other side of the outline of the guard ensuring proper alignment of sheets. Page 15 is then placed on the outline, keeping its edges well aligned. The protruding edge of the guard from page 2 is pasted on the margin of page 15 which already has the paste. Page 13 is then placed over page 15 with its fore-edge drawn in approximately 2.5 mm. from the fore-edge of page 15 and their heads properly aligned. Protruding guard from page 4 is then pasted over it. Likewise, pages 11 and 9 are pasted to guards on pages 6 and 8 respectively. After the paste has dried the protruding and unattached portions of the guard strips from pages 9, 11 and 13 are torn off with the help of a straight edge. The sheets are then folded individually and the folded sheets kept inside one another to form running text from pages 1—16.

Filling in get-in-paper

After all the sheets of a volume have been guarded and gathered into sections, they are kept in a hand press to reduce the swelling at the back of the volume. The thickness at the edge where the document and the guard paper overlap becomes greater than that of the back at the folded guard and the volume will tend to spring open at the fore-edge if bound as such. To

balance this extra thickness, additional paper slips of 5 cm. width and of the same length as the guards are folded and inserted between the folds of the guards. The blanks are inserted between successive folds of the sections, there being no get-in paper on the outermost side and the innermost fold. The volume is again pressed in a hand press and knocked at head and back to align the folds properly. Any extra portion of the guards and get-in paper at the tail is cut flush with the volume. It may then be sewn and bound.

Binding materials

As has been already pointed out in the foregoing paragraphs, life and durability of a binding depend much upon the quality of materials used in its formation. Specifications of commonly used materials for this purpose, given in Appendix III, have been drawn up with a view to ensure durable binding. Nylon thread, pyroxylin or vinyl coated cloth and polyvinyl emulsion type adhesives are some of the more recently developed materials which seem to promise better suitability for durability of bindings.

VI. CARE AND REPAIR OF MANUSCRIPTS ON BIRCH BARK AND PALM LEAF

Birch bark and palm leaf have been used for writing purposes much before the advent of paper in India. Birch tree is mostly Himalayan in origin and a number of birch bark manuscripts belonging to the 6-7th century A.D. exist in Kashmir. Palm tree is very common in South India, Bihar and Bengal, and its leaves have been more widely used than the birch bark. A large number of palm leaf manuscripts are in the custody of various organisations and individuals throughout the country. Most of the palm leaf collections date back to the 11th or 12th century A.D. Manuscripts written as early as the 7th century A.D., are reported to be in Nepal.

Birch bark sheets used for writing purposes usually consist of a number of thin layers, while palm leaves used for writing are reported to be of two varieties, *i.e.*, *tala* and *sritala*. *Tala* leaf is thick and coarse and is difficult to handle. It does not absorb writing ink, and therefore characters have to be inscribed with a stylus on the surface and filled in with a pigment, *viz.*, carbon. *Sritala* leaf is thin, flexible, beautiful, and can be handled like paper. Since birch bark and *sritala* leaves absorb ink, carbon ink has been used for writing purposes. This ink in certain cases does not get washed by water.

Storage conditions

The conditions of storage suited for the safe upkeep of birch bark and palm leaf manuscripts are similar to those required for paper, i.e., temperature in the range of 22-25°C (72-78°F) and relative humidity 45-55%. The methods of maintenance of temperature and humidity within these ranges have already been discussed earlier. In the absence of proper storage conditions, the thin surface layers of birch bark tend to separate and the edges of birch bark and palm leaf get curled up and show crumpling tendencies due to desiccation.

Besides controlled temperature and humidity, the manner of storage has an important bearing on the state of preservation of these materials. Various practices have been in use for storing these manuscripts. To collect the manuscripts in a bundle and tie them in between two wooden boards has been the most common practice. In the case of palm leaf manuscripts a different practice is very much in vogue. The manuscript leaves have centre holes through which a cord is passed for collecting the leaves and the loose ends of the cords are passed through similar holes in the boards in between which the manuscript is tied. This latter method is not very satisfactory, since slight uneven pressure is likely to damage the leaves at the edges of the hole. There is also the practice of keeping the manuscripts in bundles either tied in between boards or wrapped in cloth *bastas*. Although keeping the manuscripts in *bastas* protects them from dust and other surface feeders, care and caution in tying a *basta* is very essential. The manuscripts kept in bundles or *bastas*, if brittle, are likely to be damaged under pressure. The best method of storing these manuscripts is to keep the leaves loose and store them in boxes made of cardboard or wood. The size of the box should be slightly bigger than that of the manuscript sheet so that the manuscript could be easily taken out from the box with least friction between the edges of the leaves and the sides of the box.

Protection against insect pests

Birch bark contains some natural preservative chemicals (salts of salicylic acid) and insect pests have not been found to attack it. Palm leaf is, however, easily attacked by insect pests, and the most common species which infest this material is Gastrallus Indicus. In case of an infestation, fumigation of the infested material with para-dichloro-benzene or killoptera is a convenient way of eliminating the infestation. Details of the fumigation process have been described earlier.

Use of preservative chemicals protects these manuscripts from insect attack. *Pandri*, a type of grass, and *Ghora Bach*, a herb known as *acorus calamus*, have been used in the past with

success. These preservatives are tied in cloth and kept among manuscript bundles or in *bastas* containing the manuscripts. The active constituted in the grass and the herb mentioned above is an essential oil whose fragrance keeps the insects away. After the oil has volatilized, these materials lose their repellent properties. Strong insect-repellent chemicals like naphthalene or camphor are now available and their use is considered to be more effective than vegetable products described above.

Repair and restoration of brittle and faded manuscripts

Old and brittle birch bark or palm leaf manuscript sheets often require reinforcement for their safe upkeep. Chiffon repair as described earlier provides satisfactory reinforcement for both types of mansucripts. Since a small portion (1.5-2 mm.) of chiffon is left protruding round the edges, satisfactory protection is provided to these edges of the sheets. However, for extra protection, the chiffon-reinforced sheet could be inlaid in a frame of hand-made paper or pulp-board of suitable thickness depending upon the thickness of the manuscript leaf. Inlaying makes the handling of these leaves safe.

Dust accumulates on palm leaf and birch bark manuscripts if kept improperly and the writing is erased thereby. Manuscripts where the ink is not washable in water could be cleaned with a solution of glycerine in water (1:1), while those where the ink is soluble in water could be cleaned with carbon tetrachloride or acetone. Palm leaf manuscripts written in carbon ink, if faded, cannot be restorted, while in case of those inscribed with stylus, re-inking is possible. The process of re-inking consists in rubbing graphite powder with a cotton pad and cleaning the excess carbon from the surface with a cotton swab.

Birch bark or palm leaf manuscripts stuck together to form a solid block present a problem. Separation of the layers may be done by putting the sticking sheets in a bath of hot paraffin liquid. But such problems often need a careful and trained hand and should be attended to after sufficient practice in dealing with such special problems.

VII. CARE OF WATER AND FIRE DAMAGED RECORDS

Introduction

The extent of damage and the problems caused by fire and flood are mostly common with the exception that in the former case we get mass of papers with varying degrees of charring. However water still being the chief of fire-fighting agent, in the event of a major or even a minor conflagration, most of the documents in both cases need more or less similar cautious handling and treatment.

After the occurrence of both fire and flood the material that needs attention is voluminous and in dilapidated state. No doubt the handling of this problem needs a lot of preserverance, yet the setting up of a system to prevent damage, quick salvaging and restoring the bulk is of utmost importance.

Nature and Extent of Damage

After the outbreak of fire and its successful control, it may be observed that the papers that are to be salvaged fall in the following category.

Dry damage

1. Completely burnt mass.
2. Partially burnt and partially charred.
3. Only slightly charred materials.

Wet Damage

Because of fire control measures with the use of water some of the above categories of documents may be only damp, wet or completely soaked with water. The treatment required for such documents is smiliar to that required for documents damaged by water in the event of heavy rain splashing into the repository, drain burst or flood water seeping in the repository.

Treatment of charred and burnt documents

In many cases there may be papers which are completely burnt and reduced to bits. In such cases attempts at restoration are futile. However, it is desirable that such mass is properly screened and all such sheets that are charred but intact are salvaged. These may be undecipherable to the unaided eye yet could be scientifically treated and examined for bringing out the text.

Charred paper is very brittle and a very careful handling for their separation and placing each sheet in a separate cover is very necessary for their safe keeping. After such placement it is essential that no pressure is deployed on such dockets otherwise the papers which are intact, may fall to pieces. The cover containing these papers may then be held fast at three ends and placed flat in a document or transfer box.

Deciphering of the charred documents needs considerable training and experience and requires the help of infra red radiation for preparing a photo copy of the text. If it is not possible or feasible to transfer these documents to the expert agency or specialised laboratory immediately, they should be kept in the repository as a separate collection.

Partially charred documents and documents damaged and yellow due to high temperature, should be then segregated and kept in separate docket covers to be restored.

Treatment of Water Soaked & Wet documents

Documents that have been exposed to flood or rain or rendered wet, as a sequel to fire extinguishing operation, are likely to suffer damage due to rotting, attack of mildew or fungus, blocking and running of ink should, therefore, be treated as soon as possible.

As a first step it is desirable that steps be taken to prevent damage by fungus or bacterial agents. For this, documents may be sprayed with 2% thymol solution in methylated spirit. If possible, the atmosphere of the room where these documents are located may likewise be treated with this solution to annihilate the spores in the air.

Before taking up the treatment, the mass of completely soaked documents may be separated from only damp or slightly wet documents.

Excess water of soaked documents is allowed to drip away and wet papers carefully separated from one another using blunt paper knives, if necessary. These sheets may then be kept individually between white blotters and pressed lightly. Blotting paper may be changed as often as necessary.

When fairly dry, they may be ironed by placing them below a dry blotter or cloth. Alternatively, they may be spread on white blotters in a well-ventilated room for natural drying. Air-circulation may be augmented by electric fans. The temperature of the room may be raised to 30-40° by using hot air convectors (Sunflow Type). Wherever the damages are limited to a small collection use of thymol fumigation chamber may be made for spreading the wet documents and drying them by air-circulation. The bottom hole may be utilised for air circulation by keeping a sunflow type hot air circulator below it. For speedy drying, a constant air flow is very necessary and should be maintained round the clock.

The documents should never be dried by direct exposure to heat or sunlight. After separating and drying the sheets should be fumigated and repaired wherever necessary, before storage.

In case of wet volumes, after draining the excess water, the binding may be removed and wet sheets treated as above. If the sheets have excess water, no attempt may be made to separate the sheets till they are sufficiently dried to a safe handling stage. The volumes may be rebound later.

If the volumes are only damp, the damp sheets may be interleaved with blotting paper or newspaper cuttings to facilitate free air circulation within the sheets. After drying, the volumes should be fumigated before storage.

The leather-bound volumes in cases where no rebinding is necessary, may need fungicidal treatment. Use of orthophenyl phenol in concentration of 10 gms. per litre in methylated spirit is very useful for this treatment. This solution can be applied by a brush and application of leather preservation dressing may follow.

While treating the wet documents it will be desirable to see :—

(i) that the sheets are separated only after they are placed on waxed paper, oiled paper or polythene sheet for support.

(ii) that the cover of the books are in no case removed without their having been dried.

(iii) that the soaked books and papers are not mechanically pressed.

(iv) that the coloured blotting paper or docket cover is not used with the wet material.

It is possible that some mud or dirt may get accumulated on papers which can be removed by slight scrapping or washing the documents in luke warm water (35-40°C). It is however not desirable to use detergent or bleaching chemicals to remove dirt or filth. It is also not safe to dry to remove the dirt completely for it is easier to scrap these materials after the documents have dried.

Blocking of paper into a dried mass can be prevented to a great extent by a timely treatment yet there may be cases where such dried mass may have to be humidified or dampened by

keeping in between damp blotters and then carefully separated. The separated sheets should then be dried, flattened, fumigated and repaired, if necessary.

In case of papers soiled with fungi, fungus growth may be removed gently with dry cotton and the papers fumigated.

Damage to Writing

As a sequel to contact with water, the writing may bleed or get washed. The extent of damage to writing depends upon the type of ink used. It may be possible to reconstruct the smudged or faded writing, but scientific aids such as the use of ultra-violet rays is necessary. Like deciphering of charred documents, these documents are to be handled in a properly equipped laboratory.

VIII. SUMMARY OF RECOMMENDED PRACTICES

Prevention of decay and rot

Dampness, stagnant air, sunlight, and hot and dry climate bring about the deterioration of records. Deleterious influence of these agents can be minimized by avoiding rooms which are damp, improperly ventilated and dark. A dry, well ventilated and suitably lighted room is needed for proper keeping of records.

Since stagnant air favours the growth of mildew which is injurious to paper and other record materials, thorough air circulation, in every part of the record room is essential. Cross ventilation, provision of adequate number of electric fans and a few exhaust fans will facilitate air circulation in a record room.

Exposure of records to direct sunlight will make paper yellow and brittle. Exposure of records, even if damp, to direct sunlight should be avoided. Similarly records should not be exposed to direct heat.

Accumulation of dust among records is unhygienic and favours the growth of mildew. Regular dusting of records is necessary for keeping them in a tidy condition. The ideal method of dusting records will be the use of electrically operated vacuum cleaners.

Precautions against insect attack

Breeding of insects in a record room is facilitated if there are dark and dingy places like cracks, crevices and loose joints in floor and walls. Attending to such minor defects in the room as soon as they are noticed eliminates the possibility of insects hiding in those places. Presence of edibles in the record room may attract insects and as such they should not be allowed in it.

Periodic use of insecticidal powders like D.D.T., or spray insecticides like 'Pip' or 'Flit' at places frequented by insects,

i.e., dark corners, walls beneath and at the back of racks and almirahs, is a good precautionary measure to prevent insect infestation of records. While using such liquids care should, however, be taken that the books and records on the shelves are not directly sprayed upon since these liquids might stain or damage the records.

For fumigation of record rooms, only those fumigants which do not have any deleterious effect on paper and other record materials should be used. Commercial fumigants which have not been so tested should not be used for fumigation of record rooms.

Naphthalene is a good deterrent to insects, and should be kept among records on shelves. Naphthalene bricks weighing nearly ½ kg. each are available commercially and may be placed on shelves at a distance of every 1.5-2 metres.

Silver-fish which often damage the paper etc., are found on walls which are usually damp. If the records are kept in contact with damp walls, they will not only be dampened, but are likely to be damaged by silver-fish. Contact of records with walls should always be avoided. Bundles of records should not be allowed to lean against walls. Use of book-ends of suitable size should be made to keep the bundles at the ends erect.

In order to avoid contact of records with the walls, racks should be installed at least 15 cm. away from the wall. Keeping racks and almirahs away from the wall also helps cleaning of cobwebs etc. from the wall and facilitates maintenance of tidy conditions.

In case of infestation of record rooms with white ants, not only records but wooden shelves also are equally prone to damage. Therefore, as soon as any infestation is observed in a room all wooden racks should be isolated from the infested ground. Painting of the legs of racks and almirahs with crude creosote diluted with kerosene oil (1 : 2) or keeping their legs in bowls containing creosote oil safeguards the racks, almirahs

and the records stored there against white ant damage. Because of susceptibility of wood to decay by wet or dry rot, use of steel shelves is recommended in a record office.

Safeguard against damage in storage

Storage of documents in strong cardboard cartoon boxes provides the best condition for preservation. Since such boxes are not very easily available, records may be kept tied in bundles between two pieces of 5-ply-wood boards. These boards are not attacked by insects and are very strong. The ply-wood boards used for forming a bundle should be at least 2.5 cm. larger than the size of the files so that there is no folding of the edges of the files when they are tied into bundles.

For keeping the thickness of a bundle uniform it is necessary that the stitched part of one half of it is kept in opposite direction to the other half. The bundle should be tied near both ends with uniform pressure.

The bundles should be kept on the shelves preferably in horizontal position. If they are kept vertically, care should be taken to see that they rest on ply-wood edges and that there is no folding or curving of the edges of the files.

The bundles should always be lifted from the shelves lightly and should never be pulled or dragged out from their places. A depth of 30 cm. is recommended for normal bundles. Outsize bundles should be bifurcated into two bundles of convenient size.

All minor folds or tears in the papers of a file should be immediately attended to. Damaged covers should be replaced by new ones. For all repair work binder's paste (starch paste) or dextrine paste should be used. Gum and glue should never be used for repair or mending. Scotch tape or commercially available transparent sheets in which adhesive is incorporated during manufacture should never be used for mending tears, etc., since the adhesive may subsequently decompose and damage the paper.

A general principle of record repair is that nothing should be done which cannot be undone.

Precaution against fire in a record room

Use of match-stick or open flame of any kind may accidentally result in fire. Smoking should be strictly prohibited in a record room and lighting of match-stick or carrying an open flame should be banned.

Record room should be provided with adequate fire fighting equipment. Carbon dioxide (gas type) fire extinguishers are suitable for record rooms and should be placed at convenient places.

Entry of personnel in the record room should be restricted.

Windows and ventilators should be covered with wire net frames to safeguard against any sabotage or pilferage.

APPENDIX I

SPECIFICATIONS OF WRITING INK AND PAPER FOR PERMANENT RECORDS

Record ink

Ferrogallotannate. Blue Black Ink containing not less than 0.4 gm. of iron per 100 c.c. of the fluid ink is recommended for permanent records. Specifications for such an ink are given in IS: 221-1962 (revised): Specification for Fluid Ink for Registration and for Cheques and Records, issued by the Indian Standards Institution.

Writing paper for permanent records

The following specifications have been prescribed by the Indian Standards Institution IS: 1774-1961: Specifications for Paper for Permanent Records.

A. *Chemical requirements*

1. Rag content (cotton, and linen singly or mixed)	100%
2. Alpha cellulose content	85% minimum
3. Copper number	2 maximum
4. Ash content	2% maximum
5. Rosin content	1·5% maximum
6. pH	5·5 minimum

B. *Physical requirements*

1. Burst factor	25
2. Folding endurance	Minimum 250 double folds, average each direction, at 1 kg. tension under I.S.I. test conditions (Method of Sampling and Test for Paper and Allied Products, Part I, IS 1060-1956).

C. *Ageing test* (heating for 72 hours at 103° ± 2°C)

1. Retention of alpha cellulose . . .	98% minimum
2. Increase in copper number	Not more than 0·5
3. Percentage of the un-aged folding strength retained by the sample after ageing . .	50% minimum

D. *General requirements*

The paper shall be uniform in formation, thickness and substance, evenly finished, and free from specks, holes or other blemishes. It shall be suitable for ruling and writing with ink, with good erasing quality.

APPENDIX II

SPECIFICATIONS OF REPAIR MATERIALS

Hand-made paper

Hand-made paper for repair or records shall be all rag, white or cream-toned. If the paper is cream-toned the dyes used shall be fast to light. Its weight shall be 9-10 kg. (size 51×71 cm., 500 sheets) and its pH not less than 5.5.

It shall have a folding endurance of at least 500 double folds at 1 kg. tension under I.S.I. test condition.

(Method of Sampling and Test for Paper and Allied Products, Part I, IS: 1060-1956).

Tissue paper

Tissue paper for repair of records should conform to the following requirements:—

Alpha cellulose content not less than 88%.

Weight and size: 2.5-3.5 kg. (63.5×127 cm., 500 sheets).

Ash content not more than 0.5%.

pH not less than 5.5.

The tissue paper shall be free from oily and waxy constituents.

Chiffon

Chiffon used in repair shall be fine, pure and white silk gauze, having a mesh count of 33×32 per sq. cm. (83×82 per sq. inch).

It shall have a thickness of 0.085 mm. (average) and a pH of 6.0-6.5.

Oiled paper and waxed paper

The oiled and waxed paper shall be resistant to water penetration, and shall not show adhesion with dextrine or starch pastes. Its oily and waxy constituents shall not stain the document.

Recommended weight is as under:—

Oiled paper: 22.7 kg. (61×46 cm., 500 sheets).

Oiled paper : 22.7 kg. (61×46., 500 sheets).

Muslin (*Malmal*)

Muslin used for mounting of maps and charts of medium size (larger than double foolscap) shall be of fine, bleached quality, having an average thickness of 0.1 mm., and mesh count 35×28 per sq. cm. (approximately). It shall be even weave and free from knots etc., in the threads, and shall preferably be free from sizing materials.

Long-cloth

Long-cloth used for mounting maps and charts of heavy weight shall be of fine bleached quality, having average thickness of 0·1 mm. and mesh count 35×28 (approximately) per sq. cm. It shall be of even weave, free from knots etc., in threads, and shall not contain sizing materials.

Cellulose acetate foil

Cellulose acetate foil for lamination of records is normally available in 107 cm. (42 inches) width rolls, but may also be supplied in sheets cut to desired size.

The formula of the cellulose acetate foil recommended for use in lamination of records by the National Bureau of Standards, Washington, is P. 911 manufactured by M/s. Celanese Corp. of America.

The cellulose acetate foil recommended for lamination should have a thickness of .0223 mm. should be flexible, semi-moisture proof and should not change in colour and flexibility when subjected to accelerated ageing at 103° ± 2°C for 72 hours. It should be free from nitrate, and should have a stable plasticizer.

APPENDIX III

TENTATIVE SPECIFICATIONS FOR BINDING MATERIALS

A. Sewing thread

The sewing thread shall be unbleached linen or good quality cotton. It shall be unsized and not less than 3 cords. The thread used for books shall be capable of withstanding a breaking load of 2.5 kg. while that for reference volumes shall withstand a breaking load of 5.0 kg. The thread shall be soft enough not to injure the paper at turns.

B. Tapes and cords

Tapes and cords shall be of unbleached linen or good quality cotton, unsized and free from loose threads and mechanical defects.

C. Boards

The binding boards shall be single ply, hard pressed, uniform in thickness and shall be flat when made to lie on a horizontal surface. Both sides of the board shall be clean, free from loose fibres, lumps and mechanical indentations.

Characteristic requirements:

(i) *Mill board*

Thickness	Substance	Ash content	pH
Less than 1·5 mm.	1500 GSM	Not more than 10%	Not less than 6·5
Less than 3·5 mm.	3500 GSM		
Less than 4·5 mm.	4500 GSM		

(ii) *Straw board*

Thickness	Substance	Ash content	pH
Less than 1·5 mm.	1000 GSM	Not more than 15%	Not less than 6·5
Less than 3·5 mm.	2000 GSM		
Less than 4·5 mm.	3000 GSM		

D. Covering material

(i) *Art canvas/Calico binding cloth/Rexine*

The fabric base shall be unsized cotton evenly woven, free from pin holes and other mechanical defects.

The finished cloth shall be soft, pliable and shall not show cracking surface when bent sharply. It shall not show any sticking when folded upon itself. It shall allow satisfactory finishing and tooling by hand or with embossing machine.

Characteristic requirements:

Type of cloth	Weight of the finished fabric gms./sq. metre	Percentage of filling or coating over basic weight	Thread count average web and filling (2·5 × 2·5 cm.)	Ash content (percentage of finished cloth)
Art canvas . .	Not less than 400 but not more than 600	Not more than 35	70 double thread	Not more than 5
Calico binding cloth .	Not less than 150 but not more than 250	Not more than 70	110	Not more than 15
Rexine . . .	Not less than 250 but not more than 450	Not more than 80	120	Not more than 15

(ii) *Leather*

Leather shall be good quality sheep or goat skin, free from grain defect or insect damage. It shall be vegetable tanned, chrome tanned, or combination of the two. It shall have uniform thickness and shall be finished with full natural grain in colours fast to water and light. The grain shall not crack off on double folding or on rubbing with dry or wet cloth. Its surface shall be suitable for satisfactory finishing and tooling by hand or with machine.

It shall conform to the requirements prescribed in IS:2960-1964: Specifications for Book-binding Leather.

E. Adhesives

(i) Glue shall be hide glue, clean, translucent and amber colour. Liquid glue prepared for binding shall not be treated over 54.5°C (130°F) and shall contain 2-3% glycerine and 1% phenol.

(ii) Binder's Paste shall be prepared from fine *maida* (starch) and shall contain 2-3 per cent by weight of copper sulphate and 1-2 per cent glycerine.

F. End paper and paper for guarding

Hand-made paper, good quality bank or ledger paper shall be used. The paper shall have a folding endurance of over 100 double folds at 0.5 kg. tension and its pH shall not be less than 5.

G. Reinforcement fabrics

The fabrics used for reinforcement at the folds of end paper or spine etc. shall be of unsized cotton, free from weaving defects and loose threads.

The fabric shall be soft and pliable.

Characteristic requirements:

Type of cloth	Thread count warp & filling average (2·5 × 2·5 cm)	Thickness average	Weight finished fabric gm/sq. metre
Long cloth	160	0·15 mm.	120
Malmal	160	0·1 mm.	40
Gauze	40	0·15 mm.	25

APPENDIX IV

FORMULAE AND PREPARATION OF DEXTRINE AND STARCH PASTES

Dextrine Paste

Formula

Dextrine	2·5 kg.
Water	5 kg.
Oil of cloves	40 gm.
Saffrol	40 gm.
Barium carbonate	80 gm.

Procedure

Water is kept for boiling in a shallow brass vessel (*degchi*). When the temperature of water has risen to about 90°C, dextrine powder is slowly added to the hot water with constant and vigorous stirring so that formation of nodules of dextrine in water is avoided. After the addition of dextrine is complete (2.5 kg. of dextrine may take approximately 30-40 minutes), barium carbonate is added to the paste while stirring. Then oil of cloves and saffrol are added, well mixed with the paste, and the preparation of the paste is completed by cooking over fire for 6-8 minutes only.

Thin Starch Paste

Formula

Starch (*maida*)	250 gm.
Water	5 kg.
Oil of cloves	40 gm.
Saffrol	40 gm.
Barium carbonate	80 gm.

Procedure

The same as described above, dextrine being replaced by starch (*maida*).

Starch (*maida*) Paste for general repair and binding work

Formula

Starch	1 pt. in weight
Water	4-5 pts. in weight
Copper sulphate	2·5-3% of starch
Glycerine	1-2% of starch

Preparation

Small quantities of starch (*maida*) are mixed with water (requisite quantity) taken in a shallow brass vessel (*degchi*) and made into a paste taking care that no lumps or nodules are formed at the base. After the requisite quantity of starch has been so mixed, copper sulphate dissolved in minimum quantity of water (10 c.c. for every 5 gm.) is added to the paste. The paste so prepared is then cooked on fire or electric stove till it starts frothing. During cooking, paste is kept well stirred so that there may not be any charring of starch at the bottom due to over-heating. Glycerine is mixed to it at this stage and the paste well stirred.

APPENDIX V

NEW SYNTHETIC ADHESIVE FOR REPAIR OF DOCUMENTS WITH TISSUE PAPER AND CHIFFON

Sodium salt of Carboxymethyl Cellulose has shown excellent properties as an adhesive in very low concentration in water solution. This chemical is available in India from M/s. Gujchem Distillers India Limited., Valsad, Surat, and M/s. Sardesai Brothers Ltd. P.O. Sardesai Factory, Bilimora (W. Railway).

To prepare the paste a measured quantity of water is heated to 80-90°C. The heating is discontinued and sodium salt of carboxymethyl cellulose is added in small quantities with gradual stirring till a concentration of 2-5 to 3 percent (by weight) of the chemical is obtained in the solution. The solution is allowed to stand for 3-4 hours to obtain a homogenious dispersal of the chemical. This paste has good keeping qualities, maintains better transparency during chiffon and tissue repair as compared to dextrine and starch pastes, has mild mildew resistant properties, is easy to apply with a brush. If prepared correctly it is likely to retain its properties for over a fortnight.

This paste is a very satisfactory substitute for dextrine and starch for repair and mending job in archives and libraries. It has been now well tried for repair of documents in archives for last 6-7 years.

APPENDIX VI

REPAIR EQUIPMENT REQUIRED IN A RECORD OFFICE

1. Repairing table, preferably with glass top
2. Small hand press
3. Paper trimmer
4. Scissors (long)
5. Knives
6. Paring knives
7. Cups (enamelled or brass)
8. Dishes (enamelled or brass)
9. Brushes (camel hair, 2.5-1.25 cm. wide)
10. Paper cutting slices (preferably made of horn)
11. Foot-rule
12. Sewing needles (big and small)
13. Bodkin (for piercing holes)
14. Enamelled trays
15. Glass plates
16. *Degchi* for preparing dextrine and *maida* pastes
17. Electric iron.

APPENDIX VII

SPECIAL CARE OF LEATHER-BOUND VOLUMES

Good quality vegetable tanned leather is ordinarily a very stable substance, but in adverse circumstances it is liable to be attacked by insects and fungi. It contains waxy and greasy constituents which gradually volatilize in hot climate, and thus leather often loses its flexibility in course of time.

The durability and longevity of leather can be greatly enhanced by the application of leather preservative dressing to leather-bound volumes. Many varieties of leather preservative dressing are available. However, a mixture prepared with the following formula has been found quite satisfactory:—

1. Lanolin anhydrous . . . . . . 800 gm.
2. Bees-wax . . . . 15 gm.
3. Cedar-wood oil . . . . 30 ml.
4. Benzene . . . . 350 ml.

Benzene is slightly heated and the wax is dissolved in it. Cedar-wood oil is added next and then lanolin, which should be previously softened by warming. The mixture should be thoroughly shaken before using.

The reasons for combining these ingredients in this leather dressing are as follows: Lanolin is an animal fat which is easily absorbed by leather, and does not become rancid. At ordinary temperature it is in the form of a thick grease and its use will be difficult. Its application is made easy by mixing it with the liquid dressing. The wax will assist in polishing and providing a thin surface film and will reinforce any powdery or cracked portion of the leather. The cedar-wood oil is a good preservation and is useful in forming a bond of union between the lanolin and wax in the leather. Benzene is chosen as a convenient "thinner" as it readily dissolves bees-wax.

Since acidity in the leather or in the atmosphere is injurious to it, and accelerates its decomposition, treatment of leather with a buffer salt (sodium benzoate) prior to application of preservative dressing is recommended. The process of treatment is as follows:—

Superficial dust particles are first cleaned from the leather binding with a clean and soft cotton cloth. A wet swab dipped in 1-2% sodium benzoate solution is applied to it and allowed to dry. After the leather is dry, leather preservative dressing is applied to it with a brush and the volume is again left to dry. The leather dressing is then well rubbed in with cotton or cloth pad. Leather so treated retains its natural shine and flexibility.

The mixture is highly inflammable and should be kept away from fire.

APPENDIX VIII

LIST OF FIRMS DEALING IN REPAIR, PRESERVATIVE MATERIALS AND OTHER ALLIED EQUIPMENTS

The National Archives of India received frequent requests from archival and manuscript repositories for information concerning the sources of availability of the equipments and materials required for conservation of records & manuscripts. Some firms dealing with these items are therefore listed below. This list is not exhaustive and does not necessarily convey any recommendation from the National Archives of India firms listed.

A. *Chemicals*

A.1. *Fumigants and Insecticides:*

(a) Nephthelene Bricks (5″×2½″ weighing 1 lb. each) or (1.5″×1.5″×1.5″ cube).

1. M/s Bird & Co., 74, Janpath, New Delhi-110001.
2. M/s Bengal Tar Products, 6/22, Roop Nagar, Subzimandi, Delhi-110006.
3. M/s Bengal Chemical & Pharmaceutical Works Ltd., 6, Ganesh Chunder Avenue, Calcutta-700013.
4. M/s Barare Coke Co., 4, Clive Row, Calcutta.
5. M/s Shalimar Tar Products, 6, Lyone Range, Calcutta.
6. M/s National Tar Products, 74, Arvind Sarani, Calcutta-5.

(b) *Paradichlorobeneze:* Local Chemical dealers.

(c) *Thymol:* Local Chemical dealers.

(d) *Pip:* (*Liquid Insecticide*)

(i) M/s Bombay Chemical Ltd., 129-Mahatma Gandhi Road, Bombay.

(ii) M/s Geekey Sale Corporation, Vikrant Nagar, Delhi-7.

Stockist in Delhi:—M/s Gainda Mull Hem Raj, Regal Building, Parliament Street, New Delhi.

A. 2. *Preservation Chemicals:*

1. M/s B.C. & P.W. Ltd., 6, Ganesh Chandra Avenue, Calcutta-700 013. (Will supply leather preservative mixture on supplying the specific formula on a bulk order basis).
2. M/s Delhi Scientific, Ajmeri Gate, Delhi.

3. M/s Widsons Scientific Works, Sardar Thana Road, Delhi.
4. M/s Raj Derkar & Co., Regal Buildings, Connaught Place, New Delhi.
5. M/s BDH (India) Pvt. Ltd., P.B. No. 1341, Graham Road, Bombay.
6. M/s Gordhan Das Desai, Pvt. Ltd., 4/2, Jawala Mansion, Asaf Ali Road, New Delhi-1.
7. M/s Bhandari Scientific Stores, Chamminstan Building, Rohtak Road, P.B. No. 2563, New Delhi-5.
8. M/s Khalsa Scientific Works, Wazir Singh Street, Pharganj, New Delhi.
9. M/s Capital Scientific Stores, West Sardar Thana Road, Delhi-6.
10. M/s Scientific Instrument Co. Ltd., B-7, Ajmeri Gate Extension, New Delhi.
11. M/s Upper India Scientific Works, 1720, Mori Gate, Delhi.
12. M/s Reliable Scientific Supplies, Bahadurgarh Rd., Near Hathi Khana, Delhi.
13. M/s National Trading Co. Pvt. Ltd., 555, Esplanade Road, Delhi-6.
14. Manager, Cordite Factory, Arvakandu, Nilgiri Hills, South India, (for Bulk Supply of Acetone).
15. M/s Chemical de Universe Pvt. Ltd., Chemical House, 2132, Tilak Bazar, Delhi-6.
16. M/s Aggarwal Chemicals, 1077, Kucha Netwar, Chandni Chowk Delhi-6.
17. M/s Namiba Chemicals & Surgicals, Virmani Cold Storage Mansion 2-E, Jhandewala Extension, New Delhi.
18. M/s International Scientific Store, 550-51, Naya Bazar, Delhi-6.
19. M/s Hemson Chemicals, 7, Devkaran Mansion, 24-B, Vithaldas Road, Princess Street, Bombay.
20. Bhartendu Industries, P.B. No. 89, Jamnagar (Saurashtra), (for Silica Gel).

ट. *Synthetic Adhesive*

1. M/s Adhesive & Allied Products, Pvt. Ltd., 14-A, Tank Bunder Road, Bombay-10.
2. M/s National Carbon Co., (India) Ltd., Faraday House, B-17, Mission Row Extension, P.B. No. 2170, Calcutta.
3. M/s Dewan Agencies, 22, Gowalia Tank Road, Bombay-26.
4. M/s Fedco Pvt. Ltd., Mafatlal House, Backbay Reclamation, Bombay-1.

5. M/s CIBA of India Ltd., Plastics Division, P. B. No. 479, Bombay-1.
6. M/s I.C.I. (INDIA) Pvt. Ltd., 34, Chowringhee, Calcutta.
7. M/s Allied Resins & Chemicals Pvt. Ltd., 10-I, Elgin Road, Calcutta.
8. M/s Hoechest Pharmaceutical Pvt. Ltd., Synthetic Resin Division, Duggal House, Backbay Reclamation, Bombay-1.
9. M/s Industrial Chemicals & Adhesive, 10, Sussex Road, Bombay.
10. *"Mica colla synthetic adhesive"* M/s Meghdoot Paints & Chemicals, Katra Barian, Delhi-110 006.
11. M/s Pravin Brothers & Co., 501, Commerce House, Medows Street, Fort, Bombay-1.
12. *"Solvent Cement adhesive for rigid P. V. C. Pipes & other items of domestic utility"* M/s. Chemical & Plastic India Ltd., Madras-2.
13. M/s Ganjeham Distillers, Sardesai Factory, P.O. Sardesai Factory, Bilimora, Dist. Bulsar. (Sarcell-MV Carboxy Methyl Cellulose Sodium Salt medium viscosity).

C. 1. *Paper and Bookbinding Materials*

1. M/s International Impex Corpn., 18, Mothari Jamnadas Bldg., 64, Sutar Chawl, Bombay-2.
2. M/s Gujarat Trading Syndicate India House, Opp. G.P.O., Fort Street, Bombay-1.
3. M/s National Type Foundry, No. 9, Manavar Street, Bangalore-2.
4. M/s Madras Type Foundry, 30, Jones Street, Madras-1.
5. M/s Eurasia Trading & Printer Providers, Chawri Bazar, Delhi.
6. M/s Standard Type Foundry, Chawri Bazar, Delhi.
7. M/s Indo-European Machinery Co. Ltd., Chandni Chouk, G.P.O., Box No. 1499, Delhi-6.
8. M/s Wiggings Teaps & Alex, Pirie (Export) Ltd., 32, Nicol Road, Ballard Estate, Bombay-1.
9. M/s K. Orr & Co., 40-Chinnath Aurhi Street, Madras-1.
10. M/s Printers House (P) Ltd., 1/778, Nicholson Road, Delhi.
11. M/s Print & Paper (Sales) Pvt. Ltd., Chawri Bazar, Delhi.
12. M/s Printing Materials Stores, 4041, Charkhawalan, Delhi-6.

C. 2. *Tissue paper* (White, superior acid free 20"×30" 7 lbs or 11-12 Gas/sq. meter)

1. M/s Eastern Paper Mart, Chatta Shahji, Chawri Bazar, Delhi-6.
2. M/s Gulshan Rai Jain & Sons, Post Office Street, Sardar Bazar, Delhi-6.

3. M/s Jai Dayal Kapoor & Sons, Pvt. Ltd., P.O.B. 1204, Chawri Bazar, Delhi-6.
4. M/s Handmade Paper Research Centre, Poona and any other paper dealer.

Tissue paper imported

5. M/s James R. Crompton & Bros. Ltd., Elton Paper Mills, Burry, Lancashire, England.
6. M/s Spicers, 19, New Bridge Street, London EC 4, England.
7. M/s Strandford Paper Co., 3001, Vth St. N.E., Washington, (Torya Grade Tissue).
8. M/s Mather Lamm Paper Co., Washington D.C. 16, (Light weight tissue).
9. M/s B. W. Wilson Paper Co., Richmond Virginia, U.S.A. (Laminating tissue).
10. M/s Mudge Paper Co., 501, Water Street, Baltimore.
11. M/s Barton Duer & Paper Co., 1111, 2nd Street, N.E. Washington D.C.
12. M/s R. P. Andrews Paper Co., 1st & H. Streets, S.E., Washington D.C.

C. 3 *Oiled paper and waxed paper*

1. M/s Bhor Industries Ltd., Bhor Villa, Poona.
   (Regd. Office: Sir Vithal Das Chambers, 16-Bombay Samacher Marg, Bombay-1).
   Sales Div : 392, Veer Savarkar Marg, Sion, Bombay-25.
2. M/s Dharampur Leather Cloth Co. Ltd., 10-Chowpatty Sea, Bombay-7.
3. M/s Indian Waxing Co., 12, Baventala Street, Calcutta-7.
4. M/s Crescent Paper Waxer, 33-Mission Row Extension, Kent House, Calcutta-13.
5. M/s Paper Products Ltd., Vaswani Mansion, 5th Floor, 120, Dinsha Vacha Road, Bombay-1.
6. M/s Kishore Brothers, P-23-24, Radha Bazar Street, Calcutta.
7. M/s Diamond Products, 4-Clive Row, Calcutta.
8. M/s Gulshan Rai Jain & Sons, Post Office Street, Sadar Bazar, Delhi-6 and other local paper dealers.

C. 4 *Handmade paper* 28″×20″ -22 *lbs.*

1. M/s Handmade Paper Ltd., Ogalevadi P.O., North Satara District, Maharashtra.

2. M/s Khadi & Village Industries Commission, P.O. B. No. 482, Bombay.
3. M/s Handmade Paper Research Production Centre, Kalyani, West Bengal.
4. M/s Handmade Paper Makers, Cooperative Society Ltd., Sangrur.
5. M/s Handmade Paper Research Centre, Poona.
6. M/s C.S.I.R. Regional Research Laboratory, P.O. Regional Research Laboratory, Hyderabad, Deccan.
7. M/s Kasturba Seva Mandir, Rajpura (Punjab).
8. M/s Thaper Handmade Paper & General Cooperative (Industrial), Society, 71-Rajendra Market, Tis-Hazari, Delhi-6.
9. Shri Aurobindo Ashram, Pondicherry.
10. M/s W. S. Hodqkinson & Co., Ltd., 1, Tudar Street, London E.C. 4, England (imported handmade paper).
11. M/s H. Reeve & Co., Ltd., 9, Bridawell Place, London, E.C. 4, England. (imported handmade paper).
12. M/s J. B. Barcham Green Ltd., Hayle Mill, Maidstone, Kent, England (imported handmade paper).
13. M/s Wiggins Teape & Alex Ririe (Export) Ltd., Gateway House 1, Walting Street, London E.C. 4, England.
(imported handmade paper).

C. 5. *Straw Boards and Hard pressed Mill Boards*

1. M/s Paper & Pulp Conversion Ltd., Khopoli, Kolaba, Bombay.
2. M/s Union Paper & Board Mill, Ltd., 183, Netaji Subhash Road, Calcutta.
3. M/s Chandigarh Paper Board Mills, Pvt. Ltd., 26, Industrial Area, Chandigarh, Punjab.
4. M/s Straw Board Manufacturing Co. Ltd., Shardhpur (U.P.).
5. M/s Western India Paper & Board Mills Pvt. Ltd., P.B. No. 727, Bombay-1.
6. M/s Bhopal Straw Board Factory, Bhopal.
7. M/s Straw Products Ltd., 2-Mangoe Lane, Calcutta.
(and other local firms dealing in paper and boards).

C. 6. *Carton Boxes*

1. The Director General of Supplies and Disposal, Parliament Street, New Delhi.

C. 7. *Synthetic fabrics*

1. M/s Calico Chemicals & Plastic Division, 44-Rani Jhansi Road, New Delhi-55.
   (P.V.C. leather clothes).
2. M/s S. D. Mehrotra & Sons, 21, Bank Colony, Garh Road, Meerut, U.P. (Nivi Plastics woven fabrics).

   OR

   A-66, Dayanand Colony, Lajpat Nagar (IV), New Delhi.
3. M/s Union Carbide India Ltd., (Chemicals & Machine Division) 15-Mathew Road, Bombay.

C. 8. *Chiffon (quality R.D.)*

Government Silk Weaving Factory, Rajbagh, Srinagar, Kashmir.

C. 9. *Long cloth dan Muslin for Map mounting jobs*

Local cloth dealers.

C. 10. *Cellulose Acetate Foil* (0.00088 *thick*)

1. M/s British Calanese Overseas Ltd., Calanese House, Hanover Square, London W.I., England.
2. M/s Calaness Corporation of America, Plastic Div. 290 Ferry Street, New York-5, NY U.S.A.
3. M/s E.I. Du Pont De Nemours, & Co. Ltd., Wilmington, 93, Delaware, U.S.A.
4. M/s Amcel Company Inc., 180, Maidson Avenue, New York 16 NY, U.S.A. (Agents in India, M/s Industrial and Allied Chemical, Bombay).
5. M/s Mysore Acetate & Chemicals Co. Ltd., P. B. No. 772, By-sugar Building, Suri Jayachamaraja Wadiyar Road, Bangalore-2.
6. M/s Garware Plastics Pvt. Ltd., Vile Parle (East) Western Express, Highway, Bombay-57. (New Delhi), representations—Mr. M. R. Arora, Telephone No. 40656/40602.
   M/s Banwari Lal & Co. Pvt. Ltd., Own Mansion, Bastion Road, Fort, Bombay.
7. M/s La Cellophans, 110, Boulevard Hausmann, Paris-8e, France. (Size of the foil 20″×30″).
   (50.8 cm.×76.2 cm.)—500 sheets per ream wt. per ream is 5.9 kg. thickness of foil is .002 cms/23 microns).

Local Agents

M/s Volts Ltd., Chemical Divn., 7/1, Asaf Ali Road, New Delhi.

8. M/s Lonza Works, Elektro Chemische Fabriken, G.M. B.Hi 17-B, Weilam Rhein, Baders, Deutchland (Dirathwart west Germany.).

D. *Fire Fighting equipment*

1. M/s Minimax Ltd., (Incorporated in England) Mercantile Bldg., Lall Bazar, Calcutta-70001.
2. M/s Kooverji Devashi & Co. Pvt. Ltd., 10, Arun Chambers, Tardeo Road, Bombay-400 034.
3. M/s Merry Weather Fire Equipment, 805, Prasad Chambers, Opera House, Bombay-400 004.
4. M/s Zenith Fire Service, 127-129, Mody St., Bombay-400 001.
5. M/s D. G. L. Pvt. Ltd., 14-M, Block, Connaught Circus, New Delhi-110 001.

E. *Appliances and Equipment*

F. 1. *Vacuum Cleaners and Electric Ironers*

1. M/s International General Electric Co., (India) Ltd., P. O. B. No. 992, Graham Rd., Bombay.
2. M/s Associated Electrical Industries India Ltd., Nichal Road, Bombay.
3. M/s Rallis India Ltd., 10/90-B, Connaught Circus, New Delhi.
4. M/s Gardners Corporation, P.B. No. 299, 6-Doctor's Lane, Gole Market, New Delhi.
5. M/s Phillips Electrical Co. (India) Pvt. Ltd., 7, Justice Chandra Madhav Road, Calcutta.
6. M/s Hindustan General Electrical Co. Ltd., 5-Royal Exchange Ltd., Calcutta.
7. M/s India Electrical Works, Ltd., Diamond Harbour Road, Calcutta.
8. M/s Ditz. Electricals, Subzi Mandi, Delhi.
9. M/s Watts Electronics, 265, Kamla Market, New Delhi.
10. M/s General Electric Co. of India Ltd., Connaught House, Connaught Place, P.B. No. 8, New Delhi.

and other local dealers in electrical goods

F. 2. *Sewing Fog Machine*

Manufactured by

M/s Swing Fire Ltd., 94—98, Petty France, London S.W. 1, England.

(a) M/s Jardin Henderson Ltd., Indra Place, Connaught Place, New Delhi.

OR

(b) M/s Jardin Hinderson Ltd., 4, Clive Row, P.O.B. No. 73.

E. 3. *Sprayers*

(a) Ganesh Pneumtic Hand Sprayer with fine spray nozzle, Code DS-2.

(b) Aspee Baby Sprayer, Chromium plated, Brass, Containers, Code DS-5.

1. M/s Amar Nath Khandelwal, 24/157 Shakti Nagar, Subzi Mandi, Delhi-6.
   (T. No. 220368)
2. M/s. American Spraying and Pressing Works, Karve Road, Malad, Bombay-64.
3. M/s. Shaw Wallace & Co., Ltd., 8/9 Thambe Chetty Street, Madras-1.
4. M/s. Kesbo (Pvt.) Ltd., Bombay Mutual Terrace, (1st Floor Entrance from the back staircase on French Bridge) 354, Sandhurst Bridge, Bombay-7.
   (Distributors for Insect Fogger, Model-F-980.230/250 A. C. 50/60 Cycles).
5. M/s. Burgess Products Ltd., Sapcote Lencs, England.
   (manufacturers of Burgess Electric Sprayer).

E. 4. *Tell tale Clocks*

M/s. Cooke & Kelvey Ltd., 3, Scindia House, New Delhi.

E. 5. *Laminating Press Rotary*

M/s. W. J. Barrow, Director, W. J. Barrow Research Laboratory, Richmond, Virginia.

E. 6. *Laminating Press Flat Bed*

1. M/s. Baldwin Locomotive Works, Philadelphia.
2. M/s. R. D. Wood & Co., 400, Chestnut Street, Philadelphia.
3. M/s. Consolidated Products, Co/NC, 15-Park Row, New York-7.
4. M/s. Frade Carver/NC 347-Hudson Street, New York-14.

E. 7. *Steel Cabinet for vertical storages*

(Recommended by Dr. H. J. Plenderleit & Dr. Paul Caremans Unesco Experts).

1. M/s. Reneo Ltd., Bombay Life Building, Connaught Circus, New Delhi.
2. M/s. Methodex Business System, 34, Asaf Ali Road, New Delhi-1.
3. M/s. Ramington Rand, Jeevan Vihar, 3-Parliament Street, New Delhi.

E. 8. *Vacuum Fumigation Plant*

1. M/s. Horton Steel Works Ltd., 1609, North Ontario Building, Toronto, Ontario.

2. M/s. Vacudyne Altair, 375, Chicago Height, Illinois 60411.
3. M/s. F. F. Stokes Machine Co., 5910, Tabor Road, Philadelphia. 20 Pa U.S.A.
4. M/s. H. K. Porton Co., Pittsburgh-22, Pennsylvania.

E. 9. *Dehumidifier*

1. M/s. Technical Refrigeration Industries, Mangra Bhavan, No. 2, Dr. Annie Besunt Road, Bombay-1.
2. M/s. C. Doctor & Co., 11, Bruce Street, Bombay-1.

E. 10. *Temperature & Humidity : Thermographer*

1. M/s. Bestobell India Pvt. Ltd., 21, Camae Street, Calcutta-5.
2. M/s. Sehgal Sons, A-14/3 Asaf Ali Road, New Delhi.

E. 11. *Relative humidity Hair Hydrometer*

1. M/s. Sehgal Sons, A-14/3, Asaf Ali Road, New Delhi.
2. M/s. Starch & Allied Products, Electronic Division, 308, Khareb Bazar, Bombay-9.

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